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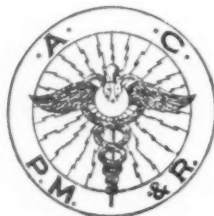
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No. 5

ARCHIVES OF PHYSICAL MEDICINE AND REHABILITATION

(Formerly Archives of Physical Medicine)

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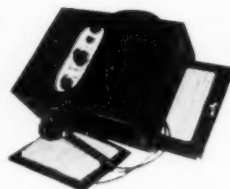
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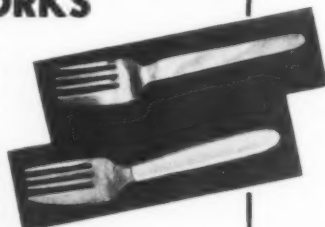
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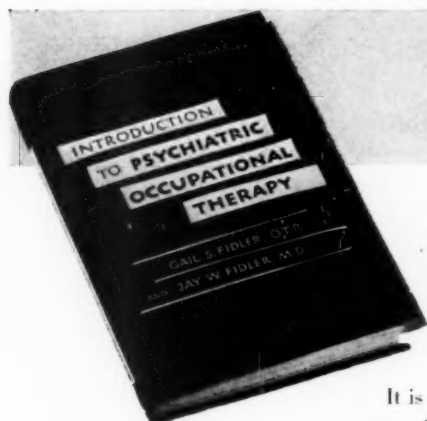


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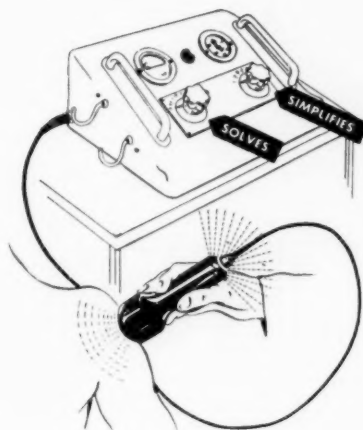
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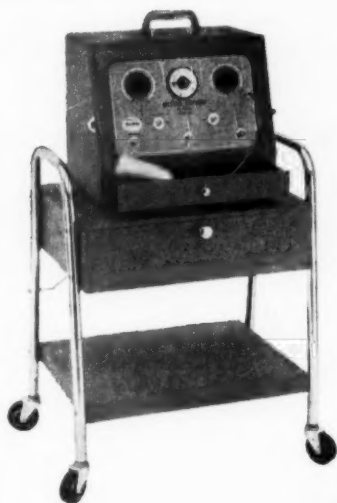
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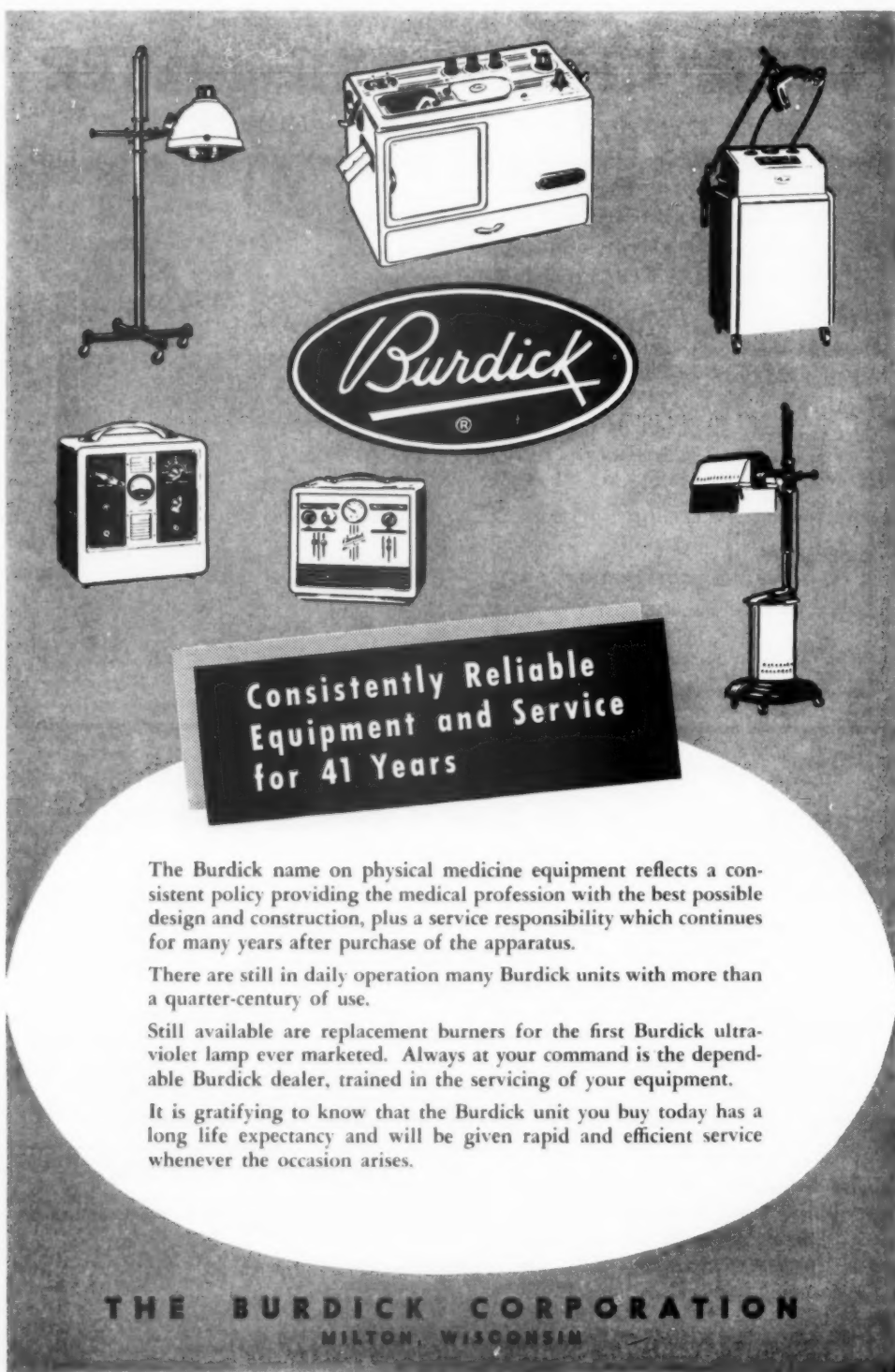
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ARTHUR T. RICHARDSON, M.B., M.R.C.P., D. Phys. Med
London

Persistent fascicular twitching of voluntary muscles occurs in a number of neuromuscular diseases, the clinical diagnosis of which is largely dependent upon coexisting signs and symptoms. If such signs and symptoms are absent, fasciculation may present a difficult but important diagnostic problem. In this paper, the electromyographic appearances of the various forms of fasciculation are described with particular reference to their origin and differentiation.

The terminology of discrete spontaneous muscle activity has tended to become confused, partly because of the different use of the term fibrillation by clinical and electrodiagnostic workers. In fact, the following four distinct electromyographic patterns may be detected by a concentric needle electrode in voluntary muscle in the absence of volition:

- (1) Fibrillation action potentials, which accompany the spontaneous contractions of single muscle fibers occurring inconstantly in denervation¹, when they are accompanied by the closely related positive potentials. They cannot be observed clinically except possibly in the tongue.
- (2) Fasciculation action potentials, (fig. 1 and 2) sometimes referred to as slow sporadic fasciculations.² They are produced by the irregular spontaneous contractions of single motor units and are visible through the skin as muscle twitches.
- (3) Grouped or repetitive motor unit potentials, (fig. 3 and 4) which are intermittent trains of repetitive motor unit activity. The larger groups have been called fast rhythmic fasciculations, or, somewhat confusingly, high frequency discharges. They accompany the spontaneous repetitive discharges of single motor units and are readily visible through the skin either as coarse twitches or slower undulating movements.
- (4) High frequency potentials, which accompany the profuse muscle fiber activity produced in the myotonias by mechanical irritation and voluntary contraction.

The phenomena of contraction fasciculation,³ resulting from loss of lower motor neurons, and pseudo-twitching from cross re-innervation arise during voluntary effort and are unlikely to be confused with spontaneous fasciculations. Of these, the muscle twitches are detected electromyographically as fasciculation potentials and repetitive mo-

tor unit potentials that are referred to by clinicians as fasciculation, coarse fibrillation, or fibrillation and which are, more often than not, regarded as poor prognosis if they occur in other than the periorbital or calf muscles. Such a prognosis can often be reversed by careful electrodiagnostic examination.

Fasciculation Action Potentials

These may be defined as spontaneous motor unit potentials of five to twelve milliseconds' duration (fig. 1), of widely varying amplitude (300 microvolts—2 millivolts) and occurring irregularly at a rate of approximately 1-50/min. Exact measurements are rarely possible because the random firing of different motor units precludes the placing of a con-

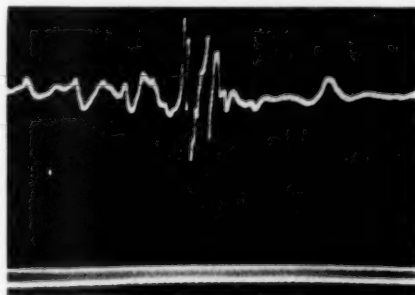


Fig. 1 — A single polyphasic fasciculation potential. From a case of motor neuron disease; millisecond time scale; magnetic tape recording.

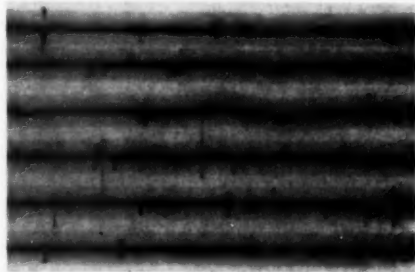


Fig. 2 — Trains of fasciculation potentials. From a case of motor neuron disease; 1 and 2, control; 3, 4 and 5, one minute after ten mg. Tensilon; 6, fifteen minutes after ten mg. Tensilon.

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centric needle electrode in close proximity to the active fibers. They are found in progressive lesions of motor nerve (anterior horn) cells, in those lesions of lower motor neurons arising from compression and in association with muscle cramps.

In motor nerve cell disease. The potentials accompanying the visible fasciculations of motor neuron disease, hematomyelia, syringomyelia, peroneal muscular atrophy, and some forms of polyneuritis,⁴ are not only irregular in amplitude, grouping and rhythm, but often of varying polyphasicity on repetition.

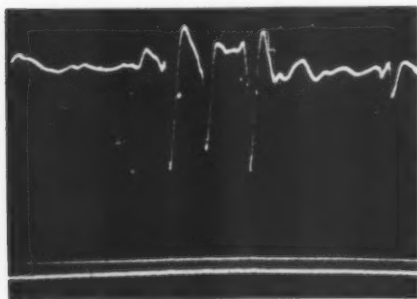


Fig. 3—A single burst of repetitive (grouped) motor unit potentials. From a case of tetany; millisecond time scale; magnetic tape recording.

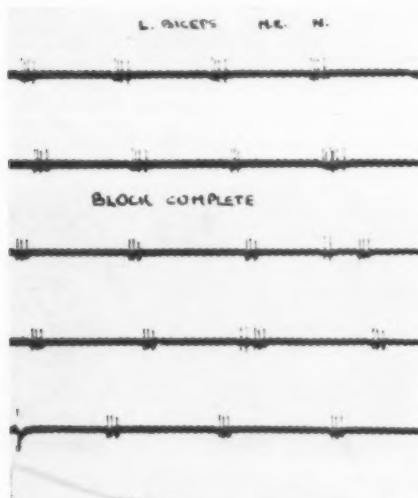


Fig. 4 — Trains of repetitive (grouped) motor unit potentials; before and after a brachial plexus block; from a case of myokymia.

The nervous impulses giving rise to this phenomenon have been regarded as originating in the motor nerve cell,⁵ but their continuation after procaine block or section of the involved nerves indicates their peripheral origin.^{6a,b} The fact that such fasciculation potentials can be produced by the administration of neostigmine or succinylcholine to normal persons, and that neostigmine and its analogues increase them in motor neuron disease, leaves little doubt that their source is the myoneural junction. Such a thesis supposes that propagation along axon branches is responsible for distributing the activity to all the constituent muscle fibers of the motor unit. This supposition is supported by the polyphasic appearance of the resultant potential and the demonstration of antidromic impulses in neostigmine fasciculations.⁷ Further, the characteristically varying polyphasic wave-form of such fasciculation potentials on repetition suggests that the myoneural junction originating the impulse within the motor unit varies.

The electrodiagnostic identification of this form of fasciculation is aided by the detection of co-existing denervation with electromyographic signs of a myopathic lesion (reduction of the volitional interference pattern and the initiation of voluntary effort with large motor unit potentials). It is noteworthy that although the onset of muscle weakness, wasting and signs of denervation in motor neuron disease within three months is usual,⁸ cases undoubtedly occur in which the onset is delayed. The detection of fibrillation potentials is not as constant as the detection of abnormalities of intensity-duration curves in this condition. For instance, in a series previously reported¹ in nineteen cases of motor neuron disease, ninety-six per cent of the muscles examined showed an abnormal response to electrical stimulation, while in only sixty-four per cent were fibrillation potentials detected.

The use of the short acting neostigmine analogue Tensilon (edrophonium chloride; 3-hydroxyphenyldimethyl-ethylammonium chloride) intravenously in

10 mg. doses to potentiate motor nerve cell fasciculation is valuable in diagnosis. With such a dose they are strikingly potentiated for a prolonged time (fig. 2) to a degree that does not occur in normal persons.

Fasciculation potentials derived from motor neuron disease remain the most common seen in electrodiagnostic clinics, although wider appreciation of the existence of benign muscle twitching probably accounts for the increased numbers of other forms now being seen. Of these, compression and cramp fasciculations form the largest group with myokymia being the least common.

In cramps and compression lesions. The consideration together of the fasciculation potentials that can be detected in people subject to idiopathic and salt deficiency cramps, and those that can be detected in nerve compression lesions, e.g., from prolapsed intervertebral discs, thoracic inlet syndrome is convenient. This is because they both belong to the miscellaneous group of benign fasciculations whose clinical and electromyographic appearance simulates the ill-omened fasciculations of motor neuron disease. Both appear to originate in the lower motor neuron and bear a close relationship to ischemic injury which may well be one of the trigger mechanisms. Cramp fasciculations are facilitated by vascular occlusion and compression fasciculations can be initiated by it. Both may also co-exist with repetitive motor unit discharges. Cramp fasciculations may build up into long bursts of repetitive motor unit potentials (high frequency discharges) which in their extreme form are accompanied by painful muscle cramp. Similarly, bursts of grouped motor unit potentials are not infrequent in compression lesions where muscle cramps also occur, e.g., leg cramps as a symptom of prolapsed lumbar intervertebral discs.

Cramp Fasciculation Potentials

These, which have been investigated by Denny-Brown and Foley,⁹ occur classically in the calf muscles and are more transient than the other forms. They

follow the general characteristics of fasciculation potentials and like those of motor neuron disease are irregular in rhythm and often of varying polyphasicity. Their polyphasic form and their cancellation by volitional activity seems to indicate that they arise in the terminal branches of the lower motor neuron and have a changing focus of origin. This is unlikely to be at the myoneural junction because they are not influenced by neostigmine.⁹ Unaccompanied by signs of denervation, they are readily distinguished as a benign form of fasciculation.

Compression Fasciculation Potentials

This form also follows the general characteristics of fasciculation potentials in being spontaneous arrhythmic motor unit discharges, but they are usually of a simple diphasic form.¹⁰ Their form tends to remain constant on repetition although co-existence with repetitive motor unit discharges is evidenced.

The relationship between fasciculation potentials and repetitive motor unit potentials occurring in compression lesion and evidence of their origin has been discussed by Kugelberg.¹¹ He has shown that during compression from a vascular cuff, spontaneous single motor unit discharges occur; whereas following the relief of such compression, bursts of grouped motor unit discharges are produced. By the use of two cuffs, he demonstrated¹² that the point of origin of these impulses was in the proximal part of the lower motor neuron. Such experimental evidence is supported by the occurrence of these discharges in compression lesions of that part of the neuron and their constant wave form on repetition.

Accompanying signs of denervation are usual in these lesions. In a series previously reported¹³, spontaneous motor unit activity was detected in twenty-four per cent of cases of nerve compression with neurological signs, while signs of denervation (fibrillation potentials) were detected in fifty-one per cent. An aid to their electrodiagnostic identification is their usual localization to the muscles

supplied by a single nerve root or trunk, and alteration in their rhythm by neck positioning, traction, etc. A notable exception to this localization is the widespread fasciculation which may occur in the arms of patients suffering from degenerative articular changes in the cervical spine (cervical spondylosis).

The effect of Tensilon on the fasciculations of these compression lesions is now being investigated and preliminary results indicate that, in contrast to the fasciculations of motor neuron disease, generative articular changes in the cervical spine (cervical syondylosis).

Grouped or Repetitive Motor Unit Potentials

These may be defined as bursts of the repetitive discharge in identical form of a single motor unit (fig. 3). Each burst can vary from 2-200 repetitions. The longer ones produce a picture comparable with the high frequency potentials of the myotonias and therefore are sometimes referred to as high frequency discharges. However, they lack the profusion and bizarre form characteristic of the latter condition. These long bursts are of widespread occurrence and may even be detected in normal muscles.

The usual form of grouped motor unit potentials is groups of 3-6 repeating at a frequency of approximately 1/sec. - 1/min. with striking regularity (fig. 4). In this form they have been detected in compression lesions of nerve roots and trunks, facial spasm¹⁴ tetany,¹⁵ uremia, and myokymia⁹. They are also of rare occurrence in motor neuron disease where the longer bursts are the rule¹⁸.

Myokymia. First described by Schultz¹⁶ in 1895, this benign form of muscle twitching may occur in isolated muscles, usually the calf or small digital muscles, or be widespread. The majority of cases are of unknown etiology, but some are said to be associated with infection. A hereditary form has been described¹⁷ and it has been seen in association with thyrotoxicosis and subsequently relieved by thiouracil¹⁸. This latter case, a housewife of fifty-eight years,

exhibited the widespread form of the disease which had persisted for three years without weakness, wasting, or signs of denervation. The widespread distribution of the twitches allowed full investigation of their origin. The activity in the leg muscles was not influenced by spinal anesthetic nor that in the forearm muscles by brachial plexus block, (fig. 4) neostigmine, or Tensilon, but it ceased with curarization by *d*-tubocurarine. It therefore appeared that the origin of the discharge was in the lower motor neuron and indeed their similarity to repetitive motor unit discharges of compression lesions suggests that the proximal part of the neuron is at fault. Such a view is contrary to the theory that incriminates the motor end-plate, but is in agreement with the conclusion of Denny-Brown and Foley⁸.

This attempt to systematize muscle fasciculations is based on the electromyographic appearances accompanying such involuntary activity. Division into two groups is readily made on such appearances. Single motor unit fasciculation potentials occur in progressive motor cell disease, and occasionally in nerve compression lesions and cramps; the latter being distinguished by absence of signs of denervation. Differentiation between motor neuron disease fasciculations and the rarer compression fasciculations may be difficult, but is important because of the poor prognosis associated with the former. Repetitive or grouped motor unit discharges occur occasionally in compression lesions, rarely in conditions of hyperexcitability of the lower motor neurons, e.g., tetany and in myokymia. They are nearly always benign and certainly so if unaccompanied by electrodiagnostic signs of denervation.

Summary

The electromyographic appearances of various forms of involuntary muscle twitching (fasciculation) are described and classified. Experimental evidence indicating their origin and mechanism is reviewed and the existence of benign forms of muscle fasciculation emphasized.

Discussion

Edward B. Shires, Lt. Col., MC, USA (Phoenixville, Pa.): Many of us who are working with electromyography have long been confused by the various involuntary potentials, other than fibrillation, which occur in pathological entities of the lower motor neuron and occasionally in the normal. The presence of these pathologically appearing involuntary potentials in the normal of times tends to confuse an already confused electrodiagnostic picture. The author, in his paper, has attempted to classify certain of these involuntary potentials encountered in the electromyographic examination. First, he has classified them on a purely wave pattern basis grouping them into 1) fasciculation action potentials and 2) grouped or repetitive motor unit potentials. Further classification of the malignant and benign types of fasciculation is made. The former occurs chiefly in motor nerve cell disease, while the latter occurs in idiopathic and salt deficiency cramps, nerve compression lesions and myokymia. He has further reviewed the literature relative to the possible point of origin of the various fasciculation potentials. This subject in the past has tended to be rather confused. However, the work of Denny-Brown and Pennybacker, of Forster and Alpers, in addition to that done by the author himself, has been of great value in untangling the misconception that all fasciculation potentials are caused by some involvement of the anterior horn cell or root of the peripheral nerve.

The author has quite adequately gathered together and presented the physiological and pharmaceutical evidence in each of the types of fasciculation, with reference to the probable site at which the impulse originates. In perusing the literature in regard to this subject, I should like to quote from an article published by Denny-Brown in 1949, in which he discussed the occurrence of fasciculation potentials in progressive muscular atrophies. He states, "These experiments indicate that the abnormal impulses can take origin in the peripher-

al portion of the motor nerve. Yet the usual site of origin of these abnormal discharges is still in doubt. The nerve cell certainly undergoes a primary histologic change, and I prefer to regard this disease as the outcome of disorder of the whole excitable cell membrane, rather than to postulate separate peripheral and central factors in its mechanism. The physiologist finds no essential qualitative difference between the excitability of the synapse and that of the axonal membrane. The neuropathologist, likewise, may find that the true explanation of progressive muscular atrophy rests in a disorder of enzyme activity underlying the excitability of the motor neuron as a whole."

I should like to add an observation of my own to those of Dr. Richardson. On several occasions during the past two to three years while performing electromyographic determinations on the Myotonias, I have noted small involuntary diphasic potentials which, on first observation, appeared to fall within the category of fibrillation potentials. However, on closer inspection, these potentials were found to be similar in amplitude and duration to Dr. Richardson's fasciculation action potential. These waves were described by him in a previous publication. These potentials are still present following curarization.

I should like to take this opportunity to thank the author for classifying a very confusing and important group of wave forms found during electromyographic examination.

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Changes of Potentials and Temperature Gradients in Membranes Caused by Ultrasound

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Introduction

According to many investigators¹⁻²⁴, various biologic and therapeutic ultrasonic reactions are of rather complex origin. The thermal component of the ultrasonic effect is quantitatively dominant. However, the heating effect is highly specific, because ultrasonic energy increases the temperature at the interfaces of the tissues selectively. This fact is of special interest in the therapeutic application of ultrasound. It has been demonstrated that there are in addition nonthermal, mechanical effects. For example, the permeation of ions is not only enhanced by the selective rise of temperature at these interfaces; it is also augmented by a stirring effect of ultrasonic energy. This stirring effect diminishes the diffusion layer and increases the gradient of concentration of the ions at the interface.

The effect of ultrasonic energy on the potentials of various biologic membranes is of great interest, because these potentials are characteristic of the properties of the living tissue at the interfaces and surfaces. Therefore the changes of these potentials caused by ultrasound may give valuable information concerning the effects on the living organism under therapeutic conditions. The isolated frog skin was especially suitable for our investigation, because it was known from previous experiments²⁵ that the properties of the skin, such as its permeability to the passage of ions, are altered by ultrasound. Furthermore, the potentials measured across the skin and their location in the tissues have been studied in

detail by many physiologists. According to Amberson and Klein²⁶, and to Sumwalt, Amberson and Michaelis²⁸, the potential measured across the frog's skin is the sum of at least three different potentials. The main potential or so-called biopotential is located in the exterior layers of the skin, probably in the epithelium^{26,27}. Ussing²⁷ has shown that the biopotential is caused by an active transport of ions through the membrane. It can be measured if Ringer's solution is applied to both sides of the skin. Huf²⁸⁻³⁰ demonstrated that this potential is based on the intact metabolism of the skin. It disappears when there is hypoxia of the tissue and after poisoning with potassium cyanide (KCN), sodium sulfide (Na₂S) or carbon monoxide (CO)³¹⁻³⁶.

Another potential is produced by the electrical charge of the proteins, which are essential for the physico-chemical structure of the skin. Therefore the potential is dependent on the pH value of the surrounding solutions and it has an isoelectric point characteristic of the properties of the proteins involved. This potential is also located in the epithelium²⁸. Finally Sumwalt, Amberson and Michaelis²⁸ have shown that there exists a third diffusion potential. It is encountered only when saline solutions of different concentration are applied to the interior and exterior surfaces of the membrane. According to Höber³⁷, this potential is located in the interior layers of the skin.

Because of the different ways in which the potentials described are produced, it was expected that information could be obtained concerning the primary ultrasonic effect on the various structures of such a biologic membrane. This assumption was made especially because the

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The experimental work on which this paper is based was performed at the 1 Medizinische Universitäts Klinik, Frankfurt/Main, Germany.

potentials are based on certain vital functions of the cells, such as the maintenance of the physicochemical structure of the proteins and the selective permeability for ions with an electrical charge. Furthermore, it was of interest to determine whether there was specificity of the heating effect of ultrasonic energy, by studying whether gradients of temperature were created in a membrane, which might be biologically effective along distances of the order of the microscopic structures of the tissues.

Methods

The ultrasonic generator used in this study applied a constant voltage to the crystal of the applicator. This voltage was modulated only by the ultrasonic frequency. This frequency was crystal controlled. Tuning was not necessary. The radiating surface of the applicator was 10 sq. cm., the frequency 1 megacycle. The ultrasonic output was measured with a calorimeter and with an ultrasound pressure balance. In addition, the intensity was checked with a special sound pressure balance and a calibrated probe¹⁰. The standard deviation of the measurement was approximately ± 5 per cent. The skin was exposed to ultrasound in the far field⁹. The output was 30 watts (3 watts/sq. cm.). The ventral skin of female *rana esculenta* weighing approximately 25 gm. was used for experimentation. The frogs were decapitated and pithed. Then the skin was stripped off and inserted into the apparatus. The latter was made of two glass tubes connected by a ground joint. The circular opening (2 cm. diameter) between the tubes was covered tightly with the skin. The skin was always inserted in such a manner that the ultrasonic waves entered the interior part first. The glass tube was closed at the end nearest the ultrasonic applicator by a thin rubber diaphragm. The other end of the tube consisted of a glass wall, which was covered by a layer of absorbing glass wool. The whole apparatus was submerged in a water bath of constant temperature. Agar bridges were inserted into each of the two sections of the glass tube. Two openings were made, which served as

inlet and outlet for changing the solutions. The agar bridges connected the liquids in the glass tube with the saturated calomel half-cells, the temperature of which was kept constant during the experiments. The potentials across the skin were measured with a potentiometer with an accuracy of 0.07 millivolts. The observed potentials were drawn as positive curves in the diagrams when the charge of the inside of the skin was positive and that of the outer surface negative.

In order to measure the biopotential a buffered Ringer solution was applied to both sides of the skin according to the technic of Huf²⁰⁻²². The metabolism of the skin was inhibited with potassium cyanide (KCN) according to the method of Huf. The isoelectric point of the proteins was measured with the technic of Sumwalt, Amberson and Michaelis²³. Sodium acetate was used as a buffer. The free diffusion potentials encountered do not interfere with the result, since they are small and constant. The pH of the solutions was checked before use. Maximal deviations of ± 0.01 pH from the desired value were allowed.

The so-called diffusion potentials were measured in the following way. The biopotential was determined as already described. Then, the Ringer's solution applied to the exterior surface of the skin was replaced through rinsing by a 1:100 diluted Ringer's solution. The potential was measured one minute later. Afterwards the biopotential was measured again after the diluted solution had been removed. The biopotential, as compared with the main potential of the controls, was not changed essentially by these manipulations. However, the observed potential decreased when the diluted solution was applied. The difference between the values of the biopotential, measured before and after the change of the solution, and the potential obtained during application of the diluted solution was called the diffusion potential because it is caused in some way or other by a diffusion process from the concentrated to the diluted solution. The active transport of sodium ions from the outside to the inside of the

membrane (Ussing²⁷) is hampered presumably by the gradient of concentration which is established. This potential also was plotted in the diagrams as positive. The average temperature of the skin was measured during exposure to ultrasound. However, no significant deviation of the readings was observed as compared with the measurements taken in the experiments on the biopotential without changing the solutions. All curves shown in this paper are based on an average of fifteen experiments each. The standard error of the mean is indicated in one of the diagrams (fig. 4). The quotient $A =$

$$D \sqrt{\sigma_{M_1}^2 + \sigma_{M_2}^2}$$

was determined for all corresponding values of the curves to be compared. The standard errors of the mean of the values to be compared are σ_{M_1} and σ_{M_2} . D is the difference between two compared values of the curves. This difference was defined for the given number of experiments as statistically significant if the quotient A were greater than 4 (likelihood 99.7 per cent) (Koller²⁸). It was assumed that two curves were statistically different if the statistical evaluation, just described, had a significant result in at least five pairs of corresponding values. Values were regarded as identical within the limits of the statistical error if the quotient A were smaller than 2.

The thermoelectric measurements of temperature were performed as described previously^{12,20}.

Experiments

It was necessary first to study the changes of the biopotential during and after exposure to ultrasound. There were three distinct periods of observation in these experiments. The first period consisted of control observations. During the second period (period of treatment) ultrasound, heat or stirring was applied. The third period was for the purpose of

observing those effects which remained. The temperature of the surrounding solutions was 30 C. As shown in figure 1, the potential dropped during application of ultrasound. The change was irreversible during the period of observation. The average temperature of the skin was measured with a thermocouple in another series of experiments during exposure to ultrasound. The temperature was raised to 36 C. in the tissue.

The increase of average temperature of the skin obtained during application of ultrasound was not sufficient to explain the effect of ultrasonic energy. If the skin were heated to 36 C. by increasing the temperature of the surrounding water bath, a curve of the potential was obtained which was identical with that of the controls (fig. 1). This result could be interpreted in the following way. The

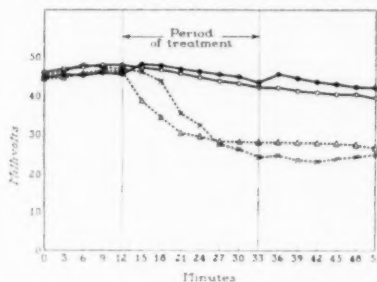


Fig. 1 — The effect of ultrasound and heat on the biopotential: (1) Controls at 30 C. \circ — \circ ; (2) Effect of ultrasound (3 watts/sq. cm., 1 megacycle) when the temperature of the surrounding liquids was 30 C. \triangle — \triangle ; (3) Effect of heating to 36 C. \bullet — \bullet ; (4) Effect of heating to 41 C. x — x . In (3) and (4), the heat was applied during the period of treatment only; otherwise the temperature was 30 C.

soldered junction of the thermocouple can measure only the average temperature because of its relative large size. Therefore the question was raised as to whether the temperature of the epithelial layer of the frog skin was selectively increased. The epithelium is considered to be responsible for the production of the main potential. In consequence of this assumption an effort was made to determine first which temperature could reproduce the ultrasonic effect. Heating to 41 C.; $\sigma_M = \pm 0.1$ C. created the same decrease of the biopotential as

ultrasonic energy (fig. 1). The temperature of 39 C.; ± 0.1 C. had less effect. But heating to 44 C.; ± 0.1 C. produced a more marked decrease of the curve than was observed after ultrasonic treatment (fig. 2).

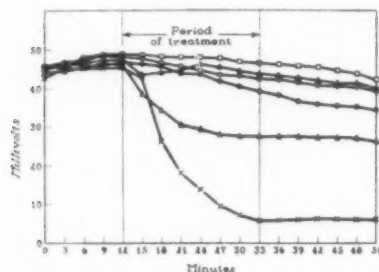


Fig. 2 — The effect of ultrasound, heat and stirring on the biopotential: (1) Controls at 30 C. \circ — \circ ; (2) Effect of ultrasound (3 watts/sq. cm., 1 megacycle) when the temperature of the surrounding liquids was 30 C. \square — \square ; (3) Effect of ultrasound (3 watts/sq. cm., 1 megacycle) when the temperature of the surrounding liquids was 25 C. \triangle — \triangle ; (4) Effect of ultrasound (3 watts/sq. cm., 1 megacycle) when the temperature of the surrounding liquids was 20 C. \bullet — \bullet ; (5) Effect of heating to 44 C. \times — \times (Here, in (5), the heat was applied during the period of treatment only; otherwise the temperature was 30 C.); (6) Effect of stirring at 30 C. \square — \square .

Therefore, question arose as to whether this temperature of 41 C. was the actual temperature of the epithelial layer of the skin. This assumed temperature was decreased in the epithelium to a biologically ineffective degree of 36 C. by lowering the temperature of the surrounding liquids during exposure to ultrasound from 30 C. to 25 C. No ultrasonic effect was observed under these conditions (fig. 1). This result suggested that, in the foregoing experiment, the ultrasonic energy actually produced a temperature of 41 C. in the epithelium.

If ultrasound were applied when the temperature of the surrounding liquids was 20 C., the observed curve was also identical with that of the untreated controls. We concluded from this experiment that the observed decrease of the biopotential was due to the thermal component of the ultrasonic effect and not to another nonthermal effect dependent on temperature. It is very unlikely that such

a nonthermal effect had the same dependence on temperature and the same temperature threshold as the effect of heat itself.

According to previous investigations¹², ultrasonic energy increases the diffusion of ions through the isolated frog skin by a stirring effect. Since Höber¹³ and Ussing¹⁴ had assumed that the biopotential is based on a selective passing of ions through the membrane, it was conceivable that the stirring effect of ultrasonic energy could influence the biopotential. However, experimentally, no significant effect of stirring alone was found (fig. 2) even if 450 cc. solution per minute passed the glass tube on each side of the skin. This result is in good agreement with the fact that the temperature rise was sufficient to explain the ultrasonic effect.

Finally it seemed necessary to prove that the observed ultrasonic effects were actually connected with the biopotential which is located in the epithelium of the skin and based on the intact metabolism of the cells. No ultrasonic effect on the potential curve was observed if the aerobic glycolysis was inhibited by potassium cyanide (KCN) (fig. 3). Therefore, it was concluded that the observed drop of the potential curve during exposure to ultrasound was indeed an effect on the biopotential.

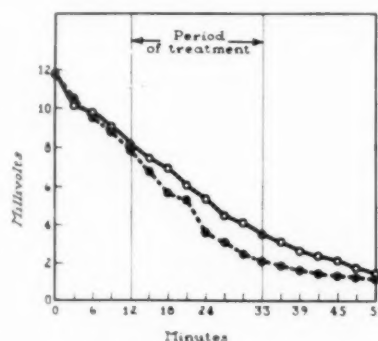


Fig. 3 — The effect of ultrasound after poisoning of the biopotential with potassium cyanide: (1) Controls at 30 C. \circ — \circ ; (2) Effect of ultrasound (3 watts/sq. cm., 1 megacycle) when the temperature of the surrounding liquids was 30 C. \bullet — \bullet .

Furthermore, it was of interest to

study in greater detail the manner in which the ultrasonic effect on this epithelial layer of the skin was produced. It had already been demonstrated that the ultrasonic effect on the biopotential could not be observed if the aerobic glycolysis were inhibited. Next an effort was made to determine whether the structure of the proteins of the membrane was altered by exposure to ultrasound. To accomplish this an investigation was made to determine whether the electrical charge of the proteins was influenced. The isoelectric point of the skin was measured. The skin was inserted into the apparatus and remained there for five minutes before it was exposed to ultrasound for ten minutes. After another period of four minutes, the measurements were performed according to the method of Sumwalt, Amberson and Michaelis²⁰. The controls remained in the glass tube for the same time as that required for the measurement to be performed. However, no ultrasound was applied. The temperature of the solutions was raised for the same period of time as that employed when ultrasound was applied in studying the effect of heat. These measurements were made at pH values of 4.8 and 5.4 for the surrounding solutions. These pH values were very close to the isoelectric point. Therefore it was possible to interpolate the curve by a straight line and to obtain the isoelectric point. As a result of these experiments it was found that, after ultrasonic irradiation, the isoelectric point of the membrane was shifted from pH 5.0 to pH 5.23 (fig. 4). It is very likely that this result is based on denaturation of the proteins involved.

Since the epithelium is responsible for the biopotential as well as for the isoelectric point of the membrane²¹ it was to be expected that heating to 41 C. would produce the same shift of the isoelectric point as ultrasonic energy provided the actual temperature during the exposure to ultrasound was 41 C. (see above). Indeed the ultrasonic effect could be reproduced by heating to 41 C. (fig. 4).

The study of the effect of ultrasound on the diffusion potential showed that

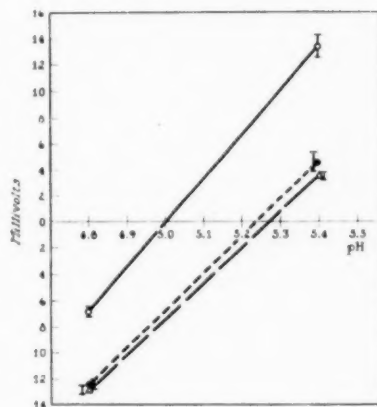


Fig. 4 — The effect of ultrasound and heat on the isoelectric point of the skin: (1) Controls at 30 C. \circ — \circ ; (2) Effect of ultrasound (3 watts/sq. cm., 1 megacycle) when the temperature of the surrounding liquids was 30 C. \circ — \circ ; (3) Effect of heating to 41 C. \triangle — \triangle [Here, in (3), the heat was applied during the period of treatment only; otherwise the temperature was 30 C.].

the potential dropped only slightly during application of ultrasound (fig. 5). However the potential was markedly less afterwards. The potentials of the controls did not show any significant change (fig. 5).

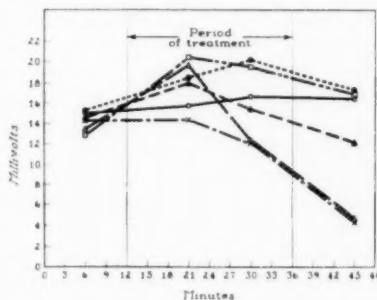


Fig. 5 — The effect of ultrasound and heat on the diffusion potential: (1) Controls at 30 C. \circ — \circ ; (2) Effect of ultrasound (3 watts/sq. cm., 1 megacycle) when the temperature of the surrounding liquids was 30 C. \circ — \circ ; (3) Effect of ultrasound (3 watts/sq. cm., 1 megacycle) when the temperature of the surrounding liquids was 22 C. \square — \square ; (4) Effect of heating to 36 C. \circ — \circ ; (5) Effect of heating to 41 C. \triangle — \triangle ; (6) Effect of heating to 44 C. \triangle — \triangle . In (4) (5) and (6), the heat was applied during the period of treatment only; otherwise the temperature was 30 C.

If the skin were heated to 36 C. no

irreversible effect was observed after application of ultrasound. The temperature of 41 C. caused a smaller drop of the potential than did the ultrasonic treatment. However, this temperature could reproduce quantitatively the ultrasonic effect on the potentials located in the epithelial layer of the skin. Heating to 44 C. reproduced exactly the ultrasonic effect. Therefore the question arose again as to whether 44 C. was the actual temperature of the interior layers of the membrane during exposure to ultrasound. The temperature of the surrounding liquids was lowered from 30 C. to 22 C. so that the assumed temperature of 44 C. in the interior layer of the skin was depressed to a biologically ineffective degree of 36 C. As expected, no irreversible effect on the potential was observed (fig. 5). Therefore it was concluded that 44 C. was the actual temperature of the interior layer of the skin during application of ultrasound.

The diffusion potentials showed a slight increase, at least during the first part of the period of treatment, when the tissues were heated to 36 C. and to 44 C. and when ultrasound was applied while the temperature of the surrounding liquids was 22 C. (fig. 5). This increase of the potentials is probably the result of several processes occurring simultaneously. It can be assumed that the diffusion potential is increased when the temperature is raised, because the diffusion coefficient is dependent on temperature. On the other hand, as has been previously shown¹², a longer persistent and sufficiently high rise of temperature markedly increases the permeability. Therefore the selective passing of ions is abolished and in consequence the diffusion potential is diminished. Furthermore, the potential might be increased by application of ultrasonic energy because the stirring effect of ultrasound augments the selective passing of ions with an electrical charge if the effect of heat is prevented by cooling. The last mentioned assumption can be checked experimentally¹³. Observations were made relative to the effect of stirring of the diluted liquid on the exterior

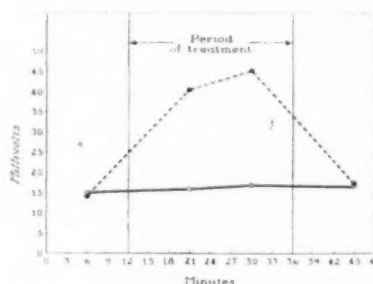


Fig. 6 — The effect of stirring on the diffusion potential: (1) Controls at 30 C. o—o; (2) Effect of stirring at 30 C. •-•-•.

surface of the skin. It was evident that stirring markedly increases the diffusion potential (fig. 6).

Discussion

As a result of the experiments described it can be assumed that the effect of ultrasound on the potentials measured across the frog skin is created in the following way: The thermal effect of ultrasonic energy was quantitatively dominant. In agreement with the investigations of several observers^{10, 11, 38-42}, this heating effect was found to be highly specific because the temperature is selectively raised at the interfaces between tissues of different acoustic impedance. The selective rise of temperature had been measured for instance in the bone³⁸ or in the nerve (Rosenberger⁴²). However, the question as to which gradients of temperature were created by ultrasonic energy in the tissues could not yet be answered. It was not known whether gradients of temperature which were biologically effective could be expected along a distance which was of the order of the microscopic structures of the tissues. It was found that the ultrasonic effect on the biopotential and on the isoelectric point of the membrane could be reproduced quantitatively by heating to 41 C. Both potentials are located in the epithelium of the skin. It could be shown that 41 C. was the actual temperature of the layer of the tissue during exposure to ultrasound. The ultrasonic effect on the diffusion potential could be reproduced by heating to 44 C., which was likewise the

actual temperature at the interior layer of the skin during application of ultrasound. From these experiments it was evident that the distribution of temperature in this thin membrane is not at all uniform. One might conclude that a gradient of temperature of approximately 3 C. along a distance of the order of $5 \cdot 10^{-2}$ cm. is created by the absorption of the ultrasonic energy. The assumption that the observed effects were owing to the thermal component can be supported by the fact that the threshold and the dependence on temperature of the ultrasonic reaction were the same as those of a heating effect. If the assumed temperatures of 41 C. and 44 C. in the different layers of the skin during exposure to ultrasound were lowered to a biologically ineffective degree by decreasing the temperature of the surrounding liquids, no effect on the curve of the potentials was observed. When the temperature was decreased further during application of ultrasound, the dependence on temperature of the ultrasonic reaction could be studied. The latter was compared with the dependence on temperature of a heating effect.

Furthermore, during the exposure to ultrasound, a nonthermal effect was noted. The ultrasonic energy decreased the diffusion layer at the membrane by stirring and therefore augmented the selective passing of ions with an electrical charge and, in this way, increased the diffusion potential.

Having discussed the biophysical mode of action of ultrasonic energy on the potentials, it was of interest for a better understanding of the ultrasonic effect on the tissues to know which structures and physiologic reactions were altered by the ultrasound. It could be shown that the biopotential, which is dependent on the intact metabolism of the epithelium, was lowered by application of ultrasound. This effect could no longer be observed after inhibiting the aerobic glycolysis by potassium cyanide (KCN). In addition, the isoelectric point of the proteins of this epithelial layer of the membrane was shifted from pH 5.0 to pH 5.23. These findings can

be interpreted by the assumption that the proteins are probably denatured by ultrasound. Therefore the physico-chemical structure of the cells is altered. Probably as a result the metabolism is decreased. This might lead to a better understanding of certain previous findings^{17,20} which indicated that there was a decrease of the aerobic glycolysis produced by the thermal effect of ultrasonic energy.

The ultrasonic effect on the diffusion potential probably can be explained as resulting from an increase of the permeability of the membrane by the heating effect of ultrasound as previously described¹². Therefore one can surmise that the selective permeability for certain ions with an electrical charge (Ussing²¹) is diminished. As a result the diffusion potential drops. But, when the selective rise of temperature in the membrane during exposure to ultrasound increases the diffusion coefficient and a stirring effect of ultrasound augments the passing of ions, and when the heating effect is not sufficient to cause an increased permeability of the membranes for all sorts of ions, then the potential is raised.

Summary

The result of the investigation suggests that the ultrasonic effect on the potentials measured across the frog skin is created by both a thermal and a mechanical component. The heating effect of ultrasound is quantitatively dominant. The reaction is irreversible over a rather long period of time. The temperature is selectively raised at the interfaces. It might be concluded from the effect on the different potentials located in different layers of the membrane that a gradient of temperature of approximately 3 C. is created by the ultrasonic energy along a distance of the order of $5 \cdot 10^{-2}$ cm.

The mechanical effect of ultrasound could be explained by a stirring effect which diminished the diffusion layer at the membrane.

The thermal component of the ultrasonic energy altered the charge of the

proteins of the membrane. The isoelectric point of the membrane was changed. The biopotential, which is based on the intact metabolism, decreased during exposure to ultrasound, but no effect was observed if the aerobic glycolysis were poisoned by potassium cyanide (KCN). Therefore it seemed likely that the potential was affected through the metabolism of the cells. Cellular metabolism is altered probably as a consequence of the change of the physicochemical structure of the cell proteins. The diffusion potential measured across the membrane dropped after application of ultrasound. This phenomenon may be produced by an increase of permeability, which results in a diminished selective permeability for ions with an electrical charge. The thermal component of the ultrasonic effect is decisive for this reaction. A stirring effect of ultrasonic energy was observed. It was encountered only during exposure to ultrasound. As a result the selective permeation of ions is enhanced not only by this phenomenon but also by the increase of the diffusion coefficient following the selective rise of temperature at the membrane.

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A Paraplegic Program Under Physical Medicine and Rehabilitation: One Year's Experience

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Introduction

In March, 1952, two wards providing a total of forty-three beds were activated as a section of the Physical Medicine and Rehabilitation Service of Crile Veterans Administration Hospital. This meant that the Chief, Physical Medicine and Rehabilitation was responsible not only for the physical medicine and rehabilitation of the patients on those wards but also for their routine care and definitive treatment. This is a report of our first year's experience under this arrangement.

Administration

When a new patient is admitted to the paraplegia ward, he is examined and interviewed by the Chief or Assistant Chief, Paraplegia Section, or in their absence by another member of the Physical Medicine and Rehabilitation Service. Routine doctor's orders are written, including immediate referral to one or more of the Physical Medicine and Rehabilitation sections. Plastic, neurosurgical, or orthopedic consultations are requested. The Genitourinary department sees the patient routinely once or twice a week unless more frequently indicated, although a member of the P.M.R. Service does the intravenous pyelograms. Grand rounds are made once a week by the Chief of the service, and all personnel working with the patient. Every patient is seen, his progress reviewed and

necessary changes in treatment are made.

The rules established for all hospital patients apply to the paraplegic patients including time for lights out, the prohibition of individual radio and television sets, (there is a bedside ear phone for each patient and the ward has a television set) gambling, drinking, etc. The paraplegic patient has no special privileges except that he is permitted to keep his car on the post, and is allowed passes to midnight on Fridays and Saturdays during the summer months.

The salient feature, therefore, of this program is that a member of the P.M.R. Service now does the examining and prescribing and, if needed, calls other services in consultation. The patient is the responsibility of the Chief, P.M.R., his passes are approved by a member of this service who has to accomplish a great deal of paper work such as histories, progress notes, medical summaries, interim summaries, discharge summaries, insurance forms, total disability forms, housing forms, and aid and attendance forms. If a paraplegic patient dies, the death certificate is signed by the Chief, Physical Medicine and Rehabilitation. After duty hours, a medical or surgical Officer of the Day covers Paraplegia during alternate months.

It is realized that a year is too short a time for a thorough evaluation of any program, but certain trends can be discussed and perhaps some general conclusions reached.

Types of Patients

In more than a year since the paraplegia wards were activated, ninety-five patients have been admitted of whom fifty have been discharged. This is an unusually high ratio of discharges, but

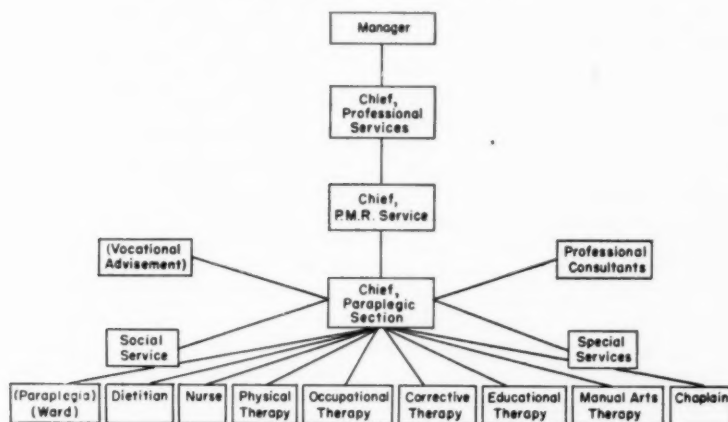
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ADMINISTRATIVE CHART (PARAPLEGIA)



it is not likely to continue since the wards are increasingly being filled with quadriplegic patients. During the first few months, the ratio of quadriplegic patients to paraplegic patients was one to five. In June, 1953, the total number of patients is forty, of whom nineteen are quadriplegias, or almost one to one. Of the ninety-five patients, eight have been negro and seventy-seven have been white. The ages ranged from 17 to 61 years with the following distribution: 20 and under, twelve; 21 to 30, fifty-eight; 30 to 45, nineteen; and over 45, six. Of this group, fifty-one were veterans of the Korean War, thirty-nine of World War II, and five of World War I. Twenty-nine were married either on admission or before discharge. Sixty-six were, and remained single. All were male patients.

Cause of Disability

Of the ninety-five patients admitted to the paraplegia section, the greatest number (38) sustained their injuries through enemy action. The causes of the other injuries are listed in table 1.

When, however, quadriplegic patients are considered as a group, the greatest single cause of injury was not the automobile, nor even penetrating wounds of the spine, but diving, which was responsible for disabling nine of the twenty-

Table 1: CAUSE OF DISABILITY

	Quadri- plegia	Para- plegia	Total
Auto accident	5	20	25
Enemy gun fire	3	35	38
Accidental shooting	0	5	5
Truck accident	0	1	1
Diving	9	0	9
Steel mill	0	1	1
Accidental fall	1	4	5
Physical training	1	0	1
Midjet auto racing	1	0	1
Train accident	1	0	1
TB Meningitis	0	1	1
TB Osteomyelitis	1	0	1
Disc	0	1	1
Epidural abscess	0	2	2
Miscellaneous disease of spine	0	3	3
	22	73	95

three quadriplegic patients.

Localization

The anatomical and physiological localization of the lesions in the fifty discharged patients varied in thirty-four patients. The physiological level based upon a neurological examination was lower than the anatomical level in twenty-seven patients, but it was higher in seven. The levels were the same in thirteen patients. In one patient, the two levels were the same on one side, and the physiological level was lower on the other side.

Among the fifty patients, nineteen lesions were listed as complete on admission, and thirty-one as incomplete, but even in the nineteen so called complete lesions, there was some evidence of return of function.

Disposition of Discharged Patients

Of the fifty discharged patients, forty-three were discharged to their homes and one to a nursing home. Six of the fifty patients died. Of the six patients who expired, five, although in a critical condition, were accepted by the Physical Medicine and Rehabilitation Service for paraplegia nursing care. One patient who had been discharged from another hospital was in fair condition on admission, but a diagnosis of chronic pyelonephritis warranted a bad prognosis.

Of the fifty patients, the average duration of lesion before admission to the paraplegia wards was forty-one months, the range being from two to 168 months. The average duration of hospitalization on the paraplegia wards was 5.8 months, the range being from one day to eighteen months. One patient, a drug addict, left after one day's hospitalization when he was informed that an effort would be made to break him of his habit.

Change in Symptoms

Pain—Ten patients complained of burning pain in the extremities. Two complained of severe pain. A cordotomy relieved one completely, but another was difficult to evaluate following the cordotomy because of a severe psychogenic overlay. Six patients tolerated their pain well and noticed a decrease before discharge. The remaining two had no decrease in their pain. Hubbard Tank, infrared treatment, and salicylates were used symptomatically. Some temporary relief was obtained, but the burning pain persisted.

Spasm—Spasm was experienced by twenty-one patients; in three it was severe. One was relieved by an anterior rhizotomy of all roots of the cauda equina. By a combination of Hubbard Tank and curare, two others were sufficiently relieved to enable them to wear braces and ambulate with crutches. In three patients the spasm decreased with routine physical medicine and rehabilitation procedures. The remaining fifteen patients showed no change in degree of spasm, but the severity was not an ob-

stacle to their rehabilitation.

Decubiti—Twenty patients had decubiti when admitted. One developed a decubitus due to injury while being hospitalized. Four were admitted with severe decubiti and these patients died of a combination of other factors without any improvement in their decubiti. Two had small decubiti which increased in size as the patients developed other illnesses which caused their death. One patient with severe decubiti and a moderately severe psychoneurosis was not cooperative and left the hospital against medical advice. The remaining twelve patients gradually improved with bed rest and meticulous nursing care. One psychotic paraplegia patient entered the hospital for dental care only, and was discharged as soon as this was completed.

Calculi—There were thirteen cases of bladder calculi which were corrected before discharge, except for one patient, a narcotic addict, who refused treatment.

Bladder Drainage—Eight patients were able to void when admitted and three additional patients were able to void before discharge. Two quadriplegic patients were admitted with suprapubic cystostomies which were converted to urethral catheter drainage. Thirteen patients who were admitted with indwelling catheters were discharged with condom attachments. Thirteen, admitted with indwelling catheters, had to be continued on urethral catheter drainage. The remaining eleven patients admitted with condoms were discharged with condom drainage. Because present patients have had their injuries more recently, a larger percentage are arriving with suprapubic drainage, and fewer with condom attachments.

Bowel Control—As one might expect, seven of the patients who had control of their bladders also had bowel control, although only two developed such control during hospitalization. Thirty patients were admitted after they had developed a manual elimination routine. The remaining thirteen had to be converted from enemata to manual elimination.

Psychiatric Status

These patients have been designated as psychoneurotic problems only to the degree that they could not conform to treatment as compared to the average patient. Half of these patients have presented no unusual psychiatric problems. Sixteen, considered as mild cases of psychoneurosis, had difficulty accepting their disabilities and required much encouragement. Four died, one became improved, but the others unimproved, were discharged to their homes. Ten patients were classified as having moderately severe psychoneurosis. Of these, four improved sufficiently so that they had only mild symptoms upon discharge and two were asymptomatic. One was so severe that he refused to eat and required intravenous fluids. Two showed no improvement; one left the hospital against medical advice, and another died. One, an addict, was hospitalized and discharged against medical advice on the same day of admission. Another was admitted from his home for dental work only. Psychiatric consultations were obtained, but were of no material benefit to any of these patients since they all refused psychiatric treatment.

Medical Complications of Discharged Patients

Of the fifty discharged patients, twenty-one, or forty-two per cent, had some medical complications during their hospitalization. Complications in ten patients were coincidental, and in eleven, may be considered as incidental to paraplegia. All of the fifty patients had marked osteoporosis, which persisted throughout hospitalization and was present at the time of discharge. The mortality was twelve per cent. The causes of death are listed in table 2. In eight of the twenty-one patients with medical complications, the complications were cleared prior to discharge. In five, the medical complication, although not entirely eradicated, was controlled sufficiently to permit discharge.

Medical complications were treated according to the necessary indications.

Table 2: MAJOR AND CONTRIBUTING CAUSES OF DEATH

Major	Contributing
Hepatitis	Intestinal obstruction
Atelectasis	Decubiti, bronchopneumonia
Pyelonephritis	Decubiti, chronic cystitis, uremia
Multiple pulmonary abscesses	Decubiti, pyelonephritis
Acute diffuse centrilobular necrosis of liver	Decubiti, lobar pneumonia
Amyloid nephrosis	Atelectasis

Two cases of malaria were secondary to military service in Korea. Meningo-myelocoele was a complication secondary to a previous rhizotomy. Pyelonephritis was present in four of the patients and was the cause of death in one. Decubitus ulcers were the direct cause of subsequent osteomyelitis in three patients. Secondary bacterial infections of the genito-urinary and the osseous systems proved to be the main medical complications.

Table 3: MEDICAL COMPLICATIONS OF DISCHARGED PATIENTS

Disease	Number
Osteomyelitis	4
Tuberculosis spondylitis	1
Pyelonephritis	3
Hydronephrosis	1
Amyloid nephrosis	1
Pneumonia, lobar	2
Atelectasis	1
Pulmonary infarction	1
Pulmonary abscesses	1
Infectious hepatitis	1
Necrosis of liver	1
Narcotic addiction	1
Schizophrenic reaction	1
Epilepsy	1
Malaria	2
Ascaris lumbricoides	1
Diabetes mellitus	1
Meningo-myelocoele	1

Operations

Surgery performed prior to admission to this hospital is not shown (table 4). Two laminectomies were performed on patients who were admitted shortly after their injuries. Other neurosurgical operations consisted of one investigation of a sinus tract of an old cordotomy, one anterior rhizotomy, and one cordotomy. The only orthopedic surgery was the pinning of a hip in a paraplegic patient re-admitted for a fractured right hip resulting from an automobile accident. This lack of surgery is probably due to the fact that patients had their paraplegia for a long period of time and therefore had indicated surgical procedures elsewhere.

When surgery is indicated, the surgeon

schedules the patient after coordinating with the Chief of Paraplegia. The patients are returned to the paraplegic wards from the recovery room except for the neurosurgical cases which are left in the neurosurgical wards from two to seven days, and then returned to the paraplegic wards. The first day or two after surgery the patients' progress is watched closely by the surgeon, but the rest of the post-operative care is given by the doctors on the paraplegic ward. If a complication arises, the situation is discussed with the surgeon and the necessary recommendations are made by him.

Table 4: SURGICAL COMPLICATIONS OF DISCHARGED PATIENTS

* Operation	Number
Lithotomy	8
Repair of penoscrotal fistula	3
Suprapubic Cystostomy	2
Circumcision	1
Ischiectomy	1
Closure of Colostomy	1
Laminectomy	2
Repair of sinus tract of old cordotomy	1
Rhizotomy	1
Cordotomy	1
Reduction of hip fracture	1

* Thirty-one patients had laminectomies done prior to admission to this hospital

Physical Medicine and Rehabilitation

The Physical Medicine and Rehabilitation program begins with the patient's admission. No consultation is needed since the Chief, Paraplegia Section is a member of the P.M.R. Service, and does his own prescribing. The entire program is reviewed by the Chief, P.M.R. during rounds. If the patient for any reason is unable to leave the ward, Physical Therapy, Corrective Therapy, Occupational Therapy, and even Educational Therapy are started at the bedside. By the nature of its activities, Manual Arts Therapy is usually confined to the shop. The Chief, Manual Arts Therapy, like all other interested personnel, attends rounds and becomes acquainted with the patients. He is thus prepared to receive them when referral is made. The treatment by appropriate personnel includes muscle re-education, functional training, routine use of ultraviolet radiation, passive exercises to maintain range of motion, correct posturing to prevent flexion contractures, progressive ambulation training for

paraplegics including driver training and self-care. Necessary aids are provided for the quadriplegic patients, who also receive routine tilt table exercises preliminary to sitting up. For those patients who need assistance with academic or commercial subjects, the Educational Therapy Section can provide such instruction. The Manual Arts Therapy Section provides a variety of industrial activities to test and increase a patient's physical, mental and social abilities in a vocational or avocational objective. All the five sections of Physical Medicine and Rehabilitation are well equipped for the rehabilitation of patients.

Participation

With few exceptions, little difficulty was experienced in obtaining patient participation in all of the Physical Medicine and Rehabilitation sections. The patient is expected to attend Physical and Corrective Therapy on schedule. He is urged but not compelled to attend Occupational Therapy, Manual Arts Therapy, or Educational Therapy. A master schedule in the office of the ward secretary makes it easy for all concerned to be alert to a patient's failure to attend any prescribed activity. The master schedules are also helpful to the ward secretary in making appointments for the patients for other care with minimum loss of activities. During weekly ward rounds, attendance lapses are discussed and necessary action is taken to prevent recurrences. It is felt that a constant emphasis upon a full day's activity not only promotes a more rapid rehabilitation, but also improves discipline and attitude. Visitors from other hospitals, as well as other services in our own hospital, have commented upon the excellent morale on the paraplegic wards.

Results

All discharged patients are included without regard to whether they did or did not complete the program. Of the fifty discharged patients, thirty-eight remained until it was felt they were ready for discharge. Most patients (twenty-three out of forty-four, or 58 per cent)

could ambulate with a wheel chair only. Included in this number are those who were instructed in brace ambulation between parallel bars, or in standing between bars even without braces. Any patient was not considered as ambulating with other than wheel chair media unless he could actually transport himself across a distance of ninety feet. Two patients could thus ambulate without any support; two required short legged braces bilaterally; two required one long, and one short legged brace and cane; one needed a cane and two short legged braces; one could do without any braces but did require crutches; three utilized crutches as well as a long legged and a short legged brace; and seven required crutches and long legged braces bilaterally. Only three could not ambulate at all. Twenty-five patients passed the automobile driving test and received Ohio State limited licenses. With reference to the quadriplegic patients, of whom nineteen are hospitalized at this time, only three are totally dependent upon assistance with their daily needs. Sixteen can feed themselves, shave, hold a cigarette, and perform other activities with the aid of simple self-help devices and a minimum of assistance. Our experience would indicate that no correlation can be made between level of injury alone and ability to ambulate. The degree of injury rather than the level is of primary importance.

Summary and Conclusions

A review has been given of one year's experience of a Paraplegia Section under a Physical Medicine and Rehabilitation Service.

Provided there is proper cooperation by all concerned, such an arrangement would appear to be feasible not only from the standpoint of good patient care, but also from the point of view of broadening the scope and responsibility of physicians specializing in Physical Medicine and Rehabilitation.

Our record of achievement among discharged as well as hospitalized patients speaks well for the total "push

program" inherent in such an arrangement.

The generally high morale of the patients would indicate their ready acceptance of and their eager cooperation with this program.

Acknowledgement — Appreciation is expressed to Dr. Joseph M. Hayman, now Dean of Tufts Medical College, who as representative of the Dean's Committee of Western Reserve University, School of Medicine, played an important part in helping to initiate our program.

Discussion

Dr. Herman J. Flax (Santurce, P.R.): My discussion of this able survey by the staff of the Physical Medicine and Rehabilitation Service, Crile VA Hospital, could very well be entitled "Prevention of the Complicating Emotional Reactions of the Paraplegia." First, let me recall that Physical Medicine and Rehabilitation owes a debt of undying gratitude to the paraplegia, whose presence in our hospital wards did more to bring about the recognition of our specialty than any other disability. Certainly, the experience at Crile VA Hospital manifests the trend of the future, not only for the rehabilitation of paraplegia but for all the severely handicapped. The grouping of patients with similar disabilities is sound rehabilitation practice. Future programs, because of economic and emotional necessity, will gravitate toward large rehabilitation centers with adjoining paraplegic villages.

It is food for thought that practically all of our papers on paraplegia discuss ways and means of getting the patient out of the hospital. Only one really important study in this country deals with a follow-up of discharged patients.

Much has been written in the past decade about the rehabilitation of paraplegics. The standard procedures require much ingenuity on the part of the staff and the cooperation of the patient. As the therapies combine their treatment of sweat, muscles and gadgets, the assembly line eventually turns out an acceptable finished product in terms of a "rehabilitated" paraplegic patient.

Throughout all of this training, we must temper our own methods to incorporate the feelings of the paraplegic.

Of interest in this respect is a study made at the Bronx VA Hospital by Dr. Robert S. Morrow and discussed last year with a group of graduate students in physical education at Columbia University. At the round table this question was asked, "If you were a paraplegic with loss of bowel and bladder control, paralysis of the lower extremities and inability to have sexual intercourse, in what order would you desire the return of the above functions, if this were possible?" Every single one of the group, all young men and women, voted for return of sexual power first, then the majority preferred recovery of the use of their lower extremities and lastly, bowel and bladder control. Not so the paraplegic veterans! They all wished for bowel and bladder control first, then power to ambulate and finally gratification of the sexual desire. This is quite a difference of opinion! But, it stems from the desire of the paraplegic to be socially acceptable; and for this, bowel and bladder control is extremely important.

Social acceptance is the most fundamental drive of the paraplegic patient, and we must take advantage of this desire to stimulate constructive thinking in an Activities of Daily Living program. I want to emphasize the importance of bowel and bladder training and point out that this problem is generally delegated to a nurse, who has so many other ward activities, that she can scarcely catch up on her nursing notes. Bowel and bladder training is tedious and time consuming, requires much patience and guidance and should not be delegated to a secondary role. For the sake of the patient, it should be placed on a par with, if not above, ambulation and the other units of a complete A. D. L. program.

Several other factors in the treatment of paraplegic patients can only be men-

tioned in this discussion. One is the value of group therapy as a means of giving the paraplegias a chance to "blow off steam," at which time the patients can get together in small groups with their physician and talk about themselves. Is it not true that the "individual's acceptance of himself is related to the degree to which he accepts others?"

The patient should be kept occupied every minute of the day. The daily program should be arranged in hourly classes and a schedule card given to the patient, who should follow this itinerary religiously. He should be instructed to wear his braces to each class all day long in order to stamp indelibly in his mind that the braces are an essential part of his body mechanism and not just an appliance to put on during the period of ambulation. In this way, every hour of the day will be occupied, the patient will have little time to think about himself, and when night comes, he will fall into bed exhausted and sleep until next morning.

As the paraplegic becomes more and more independent, his program should include more and more time for fraternizing with the outside world. This is the real advantage of the automobile which is given the patient.

There is a definite need to educate the public to accept the paraplegia both socially and vocationally. This is not easy, despite all propaganda to the contrary, and is the real stimulus on the part of many social-thinking individuals to hasten the formation of paraplegic villages with special work shops where the maximum man-power efficiency of these handicapped persons can be attained.

Finally, we should follow-up our paraplegic patients in their homes and in their jobs. We must make sure that the paraplegics use their training in the community; otherwise, their program of rehabilitation is not complete and we, as physiatrists, have failed them.

The After-Care of Fractures

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Introduction

There are three cardinal principles of treatment of a fracture: (1) to reduce displacement when present; (2) to immobilize the fractured bone adequately, to obtain bony union as quickly as possible, and (3) to ensure little or none of the functional disability which may result from the fracture and its immobilization. While the first two principles are always undertaken immediately, the third is all too frequently forgotten or neglected until as late as after removal of the plaster. This not only prolongs the period of disability, but often leads to permanent crippling, which should have been avoided. The importance of this third principle has been repeatedly stressed by Watson-Jones^{1,2}.

In order to emphasize the third principle of treatment it is convenient to consider it in two phases—maintenance of function and restoration of function.

Phase of Maintenance of Function

When the injured part has been immobilized in plaster three things have to be considered: (1) the maintenance

of movement of all the free joints of the injured part; (2) the maintenance of the tone and strength of the muscles of the injured part, and (3) the maintenance of the highest possible level of function of the injured and immobilized part.

In the upper extremity it is vital to fashion the plaster cast in such a way that full movement of all finger joints is possible, unless the fracture concerned is in a situation specifically requiring such immobilization. Active movements of the fingers through a full range must be started by the patient as soon as the plaster has set, and performed every hour of the day. The same applies to both the elbow and shoulder if these are not immobilized by the cast. The manner in which the finger exercises are done is also of great importance, for strongly performed flexion movement not only insures mobility, but also results in a firm contraction of forearm and arm muscles (fig. 1), thus helping to maintain their tone and strength. If

From the Division of Physical and Occupational Therapy, University of Toronto.

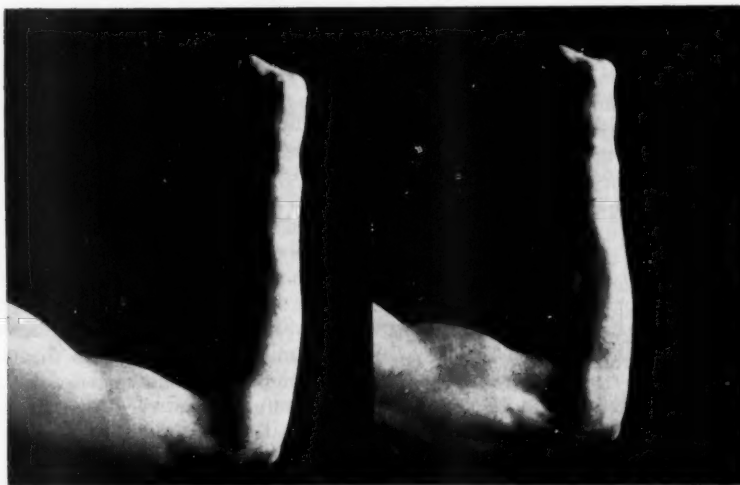


Fig. 1 — (a) Relaxed Grip; (b) Strong Grip.

the shoulder is immobilized static contraction of the deltoid (deltoid drill) should also be practiced. The patient is sent to the physical therapy department for instruction in these key exercises, until he performs them perfectly. He then repeats them hourly until the plaster is removed. Whenever feasible, the patient should be encouraged to use the injured arm as much as possible, for this helps to maintain the movement of free joints and the condition of the musculature of the limb. If difficulty in using the arm is experienced, occupational therapy is helpful in getting the patient started. Even with considerable degrees of immobilization it is amazing the things a patient can do. For example, one patient made and finished a cabinet while his left arm was in a shoulder spica for a fractured humerus.

In the lower extremity, a toe platform is of advantage only in non-weight-bearing plasters, for the intrinsic muscles can then be better maintained exercising against its resistance. It is vital, however, not to allow the platform to claw the toes, as this often leads to a fixed deformity and troublesome metatarsalgia when the plaster is removed. In a weight-bearing plaster the toes should be left free in any fracture proximal to the metatarsals, not only because their full mobility can then be maintained, but because a natural heel toe gait can be more easily achieved. There is nothing to be gained from a platform at this stage. It is also important to emphasize to the patient that toe movements, like finger movements, should be strongly performed, as they then help to maintain the musculature of the leg. Movements of the knee and hip must be practiced every hour in the same way as those of the elbow or shoulder, and if the knee is immobilized, static contractions of the quadriceps (quadriceps drill) must begin at once.

A tendency to swelling of the distal parts of an injured limb should be minimized by elevation for a few days, until it is under control by performance of the key exercises.

The function of the lower limb is looked after by teaching the patient to walk as normally as possible in the plaster. In a below-knee cast the gait should be indistinguishable from normal. This is not achieved by using rockers or steels, but by giving the patient an overshoe, such as the "Ludun boot,"* which is made of leather and has a sloped sponge rubber insole to absorb the jar of walking in plaster. It also obviates the necessity of putting a heel directly onto the cast, and building up the shoe on the uninjured side which is so often done when using a rocker. This always gives the impression that a patient is walking on miniature stilts and imparts some awkwardness to the gait. It is an axiom of after-care, that a patient who walks well in plaster, will walk well when the plaster has been removed. Instruction in correct walking until the required standard has been reached is therefore advisable.

In spinal fractures the patient should start exercises for the spinal and abdominal muscles from the beginning, and if there is any hyperextension—pulling in the abdomen from the plaster jacket—(abdominal drill) should be practiced regularly. This minimizes the "pot-belly" that is a common sequel of hyperextension. The patient should also be encouraged to do everything that the plaster jacket does not prevent him from doing.

In general, patients should be encouraged to return to work whenever possible, doing their key exercises every hour of the day themselves.

The result of a good regimen of maintenance of function reflects itself in the appearance and function of the injured part when immobilization is discontinued. The absence of swelling and the good color indicate a good state of circulation. The muscles are little wasted and weakened and can soon be restored to normal. Even the joints that have been immobilized move more easily and less painfully, than when such after-care has not been instituted.

*Information relative to this boot can be obtained from Ludun Ltd., 6 Cardiff Road, Luton Beds, England.

Phase of Restoration of Function

When the plaster has been removed, the tendency to edema in the lower limb especially, must be controlled by an elastic bandage. The movement of stiff joints must be regained, weakened muscles strengthened, and the function of the injured part restored. All these objectives are achieved by active movement and active use. What the patient does for himself is still the most important factor. He attends the physical therapy department for instruction in exercises to mobilize joints and goes on practicing them himself hourly during the day. Once a reasonable range of movement has been established, resistance exercises are introduced to build up weakened muscles^{3,4}; their development facilitates the regaining of lost ranges of movement. In the great majority of cases no other types of exercises are required. If after several weeks of repeated active effort there is no in-



Fig. 2 — Active (Auto) Assistive Exercises for Knee.

crease in the range of movement, the use of active assistive exercises (fig. 2) can be considered. They are, however, contra-indicated if they cause definite pain, for this means that the joint concerned is too sensitive and that even controlled light stretching will cause too much reaction and tend to decrease rather than increase the range of movement. Gently performed passive movement is only permissible (in fact it is essential) to *maintain* the range of joint movement in a paralyzed extremity, but passive stretching must never be allowed,

for it only increases pain and *decreases* movement. It is found in practice, that if a carefully supervised regimen of active and later active-assistive exercise does not increase movement of a stiff joint, manipulation under anesthetic will hardly ever do so, except by tearing vital structures e.g., fracture of patella or avulsion of the patellar ligament in manipulation of a stiff knee after a fractured femur. Even cases where dense adhesions are ruptured, the reaction is so great that any movement gained is lost within forty-eight hours of the manipulation. Sometimes, however, in cases where active mobilization has not been successful, it may be necessary to bring a joint into a better position of function, and a manipulation can then be tried. If this results in the required gain, then it is best to immobilize the joint in its new position for several days, until the inflammatory reaction of the new trauma has abated. The only instance in which manipulation has sometimes to be considered as a mobilizing procedure, is in the case of multi-centric segments such as the spine or foot. In them the multiplicity of joints sometimes makes it difficult to mobilize the stiff segment effectively by active exercise and the patient's effort may be dissipated in mobilizing segments already mobile. In such cases manipulation with or without anesthetic may be helpful.

Active movement is thus the keynote of both phases of the after-care of fractures, and it is very important to stress that this is the most important contribution of the modern department of physical therapy. Certain other physical methods of treatment may also be used. Heat of various kinds is useful in relieving pain and as a preliminary to joint and muscle exercise. Hydrotherapy is valuable as combining heat and active movement, particularly in the early stages. Massage, all too often prescribed, is of very limited use. It can help to loosen the adhesion of fairly recent scars, it can help to establish the most rapid control of well marked edema, and it can be used to ease the discomfort in an injured part at the end of the

day's exercise, especially in elderly patients. It is never necessary to continue massage for more than a week or two, and it must never be ordered unless clearly indicated, for otherwise the therapist will devote time to it, which could be spent with much greater value to the patient in supervised active exercises. Electrical stimulation is indicated only to diminish atrophy in paralyzed muscles and may also be used a few times when the patient is having some difficulty in getting the sense of movement of a muscle. However, in a muscle with an intact nerve supply and with good co-ordination it cannot compete with active exercise as a restorative procedure, and it should never be prescribed in such cases.

The final restoration of function in limb injuries is the shared responsibility of the physical therapist and the occupational therapist⁸. In the case of the lower limbs, walking instruction and graded weight-bearing exercises are given by the physical therapist or remedial gymnast (corrective therapist); however, occupational therapy involving use of treadle or bicycle equipment also helps to develop muscles, loosen joints and re-establish certain aspects of function. In the case of the upper limbs all aspects of functional activity can be reproduced and practiced in the occupational therapy department and it is essential in the complete treatment of the more difficult problems, especially those involving the hand. In spinal injuries as rapid mobilization as the age of the patient allows, under the care of remedial gymnasts, followed by remedial games soon restore normality,—remedial games are

in fact a valuable help in the after-care of the majority of fractures, especially when the patient is somewhat hesitant and conscious of his injured part.

Summary

In a good program of after-care of fracture cases first class instruction and supervision are necessary, from the moment the plaster is dry to the moment the patient is ready for discharge from all treatment. It is only then that the patient can make the greatest possible contribution towards his own recovery, and it is that contribution which makes the difference between best and second best results in terms of function. Both physical therapy and occupational therapy have a definite contribution to make in this program of after-care and it is strongly emphasized that in the case of physical therapy, this contribution consists essentially of a carefully planned program of active exercise.

Acknowledgement — The author is grateful to Dr. I. Macnab for his helpful comments and to the Medical Art Department of the Sunnybrook Hospital, Department of Veterans Affairs, Canada.

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Post-Hospital Rehabilitation Study of Tuberculous Patients

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and

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The in-hospital rehabilitation program for tuberculous patients now in effect at the Long Beach VA Hospital was initiated in 1946. The program constitutes a major phase of the patients' overall hospitalization and treatment plan. The Long Beach VA Hospital, which is primarily a general medical and surgical hospital with a 1600-bed capacity, includes a 450-bed tuberculosis service. The rehabilitation program, which was well under way in 1947, was reorganized in 1948 to orient the patient to the rehabilitation process at the point of hospital admission.

During the bedrest phase of the patient's hospitalization, a thoughtful evaluation of his aptitudes and capacities was made by the clinical team members, including vocational advisement, manual arts and occupational therapy. Based upon the total findings, a rehabilitation plan was evolved to aid the patient in making up educational deficiencies, to discover his vocational interests and goals, and to determine how these would be effected by his tuberculous diagnosis.

During the ambulatory phase, the patient's interests and capabilities were further explored in classes and shops to sharpen his vocational objectives. An evaluation of his physical tolerance to employment was made by actual work assignments, which also helped to estimate the stability of his residual disease. When the patient was discharged, a post-hospital plan was approved which incorporated a vocational goal, a plan for retraining, if necessary, and the initial time limits established for work or training.

This rehabilitation plan, following the patient's discharge, was supervised by the vocational advisement representa-

tive of the Veterans Administration or the State Department of Rehabilitation. The purpose of these efforts was to enable the patient to effect a successful adjustment in his return to the community, to maintain the health gains achieved, and to avoid a reactivation of his disease necessitating a return to the hospital.

The present study was initiated to ascertain how well such planning actually worked out in practice, and what difficulties were encountered which might lead to failure. A follow-up questionnaire was sent to the 113 patients who had completed their hospital treatment, ending with arrest of their disease, and who had been under such a program of rehabilitation planning. These patients had been discharged during 1948, 1949, and the first half of 1950.

The questionnaire was devised to answer the following: (1) to what degree had the patients gained vocational competence; (2) how well had they been able to stay within the graduated limits of work or training prescribed; (3) were they able to follow the planning originally approved; if not, why were changes necessary; (4) what difficulties did they encounter in obtaining employment or training limited to the hours prescribed; (5) had employment been refused because of the tuberculous condition; (6) was a part time job necessary while training; and, if so, why; (7) had the continuing medical collapse measures, such as pneumothorax or pneumoperitoneum, or surgical measures such as thoracoplasty or resection, hampered their work or training, and (8) did re-

From the Pulmonary Disease Service and Social Service, Veterans Administration Hospital, Long Beach, Calif.

activation of their tuberculous disease occur.

Of the 113 questionnaires sent out, 78 were answered. Of these, two were returned by relatives who stated that one patient had died of an accident and the other had been committed to a mental institution. Consequently, the remaining 76 replies furnish the basis of this study.

The composition of the group in relation to such factors as race, age, marital status, educational level, classification of illness, etc., reveals the following: The group was composed chiefly of young, white individuals. Seventeen belonged to groups considered most susceptible to tuberculosis, i.e., Mexican, Japanese, Filipino and Negro. Seventy-three were veterans of World War II and were eligible for training under Public Laws 16 or 346. Sixty-three received compensation for service-connected disability. Forty-seven were in the age group 20-30; twenty-three in the age group 30-40; and only five were over 40 years of age. The marital status revealed that 39 were single; 31 were married; and the remaining 6 were divorced. Twenty-two had one or two children; four had three or more; six had dependents besides wife and child. The educational level of sixty-five was high school graduation or better; of these, thirty-one had completed their high school requirements while in the hospital. Eleven had educational levels from the 4th to the 11th grade. The tuberculous disease was classified as minimal in twelve, moderately or far advanced in sixty-four. Forty-two were discharged with continuing pneumothorax or pneumoperitoneum. Twelve had had thoracoplasty, one had had resection of one lobe and three had had removal of a lung. Twenty-seven of the group had been previously hospitalized for tuberculosis. Fourteen had been discharged with arrested tuberculosis, but had become reactivated prior to this study. Thirteen had discontinued hospital treatment, either against medical advice or by disciplinary action.

A further analysis of the seventy-six replies received indicates that sixty-eight of the seventy-six patients may be considered as having been successful in their adjustment to life outside the hospital. Twenty-two have completed training and are working. Twenty-nine are still training and plan to complete their courses. Their replies indicate they are successfully maintaining their grades. Seventeen, who did not train, are working; seven of this seventeen are in businesses of their own. The remaining eight failed either in maintenance of health or in vocational rehabilitation.

The medical and social findings of the eight failures were analyzed. All eight reactivated their disease and five also failed to make a vocational adjustment after leaving the hospital. Two of these were negroes and four were of Mexican extraction. All exhibited a combination of factors considered contributory to their failure. Four worked beyond prescribed limits, four lived at marginal subsistence levels because of insufficient financial aid during the adjustment period, four started with very low educational levels, and four had unrelieved emotional maladjustments. Two tried to attain vocational goals beyond their capabilities. Two had no vocational guidance followup. Factors occurring only once were lack of motivation, addition of part time work to prescribed training, changing an approved vocational goal to one not suitable, and excess travel distance between home and training facility.

Of the twenty-two men who obtained work after retraining, all stated that they are holding their jobs successfully. All, with the exception of one, consulted their physicians for advice relative to work time limits. Ten of these, even after a period of training, were advised to work less than eight hours daily. Three felt that the doctor was too cautious; three that he was not cautious enough; but fifteen considered that the doctor's advice was geared to their overall condition. The employers of fifteen patients knew of their tuberculous diagnosis and cooperated in their early work

adjustments. It was interesting to note that in some industrial plants definite gradations of work are set up for physically handicapped employees. The employers of six men were not informed of their employees' tuberculosis. Those who told their employers and those who did not were equally emphatic as to whether the employer should be so informed.

A number of the jobs secured by those who completed retraining are of interest as demonstrating the various types of work in which an ex-tuberculous patient may be successful. These include such widely divergent fields as real estate broker, editor, commercial artist, office equipment salesman, office equipment repairman, electronics technician, accountant, auditor, loan officer, commercial photographer, magneto repairman, cattle raiser, teacher, shop supervisor, aircraft inspector, radio and television technicians, architect, methods engineer, postoffice clerk, office clerk, cost accountant, draftsman and insurance broker and salesman. Two men had sufficient in-hospital training in bookkeeping to obtain jobs in this field.

Of twenty-nine men still in training, seventeen followed the original plan, eight changed their vocational objective to a closely related field and four changed to an entirely different vocational plan. Of these four, one having completed his goal in the original field found he did not really like the work and started training as a teacher. One changed from the study of oceanography to pharmacy because he found the field training of the former too strenuous physically. Two found more interesting vocational objectives after further investigation in the post-hospital period; both of these new vocational plans met medical approval.

Information concerning the seventeen men who started to work immediately following discharge reveals that seven are in businesses of their own or in partnership and remained in the same or related work approved by the hospital discharge board. The remaining ten are working for others, and did not exactly

adhere to the approved medical plan. Five of this number, however, were engaged in the same or related fields of work approved at the time of discharge. The other five worked in entirely different jobs, three of them not considered suitable for tuberculous individuals. These three individuals had also been considered unresponsive to the hospital rehabilitation program. The reasons given for completely changing their vocational objectives were either to meet increasing financial pressures after discharge or because the approved training was too strenuous or too difficult. Only time will tell whether these three men will be able to retain an inactive status of their disease.

Only six of the seventeen who had been approved for training situations went to work without retraining. None of this group of seventeen stated that they failed to get a job because of their tuberculous condition. Fourteen stated that they were able to stay within the prescribed work time limits.

The seventeen patients required a varying amount of time following discharge in reaching a work tolerance of eight hours daily. This period ranged from two months to two years.

Fifteen of the fifty-five men (including four failures), who started retraining in schools after discharge, stated that they could not fit the training curriculum within the work time hours prescribed. Of these, two dropped training temporarily until their study loads could be increased; nine continued training but in a more limited objective; four returned to the hospital with reactivation of their disease.

Forty-two patients continued to have pneumothorax or pneumoperitoneum re-fills after discharge. Twenty-eight stated that this did not hamper work or training, nine said that it did and five did not answer this question. Of the men who had experienced major chest surgery, slightly over half stated that the effects of surgery did not prevent them from doing the prescribed limited work, although the majority did admit that they were handicapped for doing any

additional work. The remaining number felt that they were definitely handicapped in performing their prescribed work.

The social implications of tuberculous disease and treatment demanding extensive exploration, encouragement and support of the patient, may influence the success or failure of his total rehabilitation. This is substantiated in the following case reports:

Case M. G.—A 39 year old white, married veteran who has been hospitalized eighteen months for pulmonary tuberculosis. Chest surgery was considered necessary to arrest his disease, but this was refused by the patient, who stated that he was too emotionally upset. The social worker learned that the patient's wife was considering leaving him because of her marked fear of his disease. As an initial step in this direction she had already sent their child out of the state to live with relatives. After securing the patient's permission, the social worker arranged an interview with the wife at which time an interpretation of the patient's condition relieved her of the excessive fear of tuberculosis. She re-established good relationship with the patient, resulting in the relief of his tensions. He accepted surgery, which was successful, and later cooperated in discharge planning. The couple are now happily reestablished in their home and the patient is in training as a clergyman. The success of this patient's treatment and rehabilitation was directly influenced by gaining the cooperation of the marriage partner.

Case J. O.—A 26 year old Filipino had been very cooperative in the hospital treatment and rehabilitation program until his wife arrived in this country on a visitor's visa. Shortly after her arrival she began to exert pressure on the patient to leave the hospital because she was lonely. The social worker arranged a conference between her and the patient's physician to explain how the patient would risk nullifying his previous gains by leaving the hospital too early. Thereafter her attitude changed to one of active support in his treatment and rehabilitation program. She continued to contact the social worker after the patient was discharged from the hospital. With this combined support, the patient, who was overcautious and easily discouraged, surmounted repeated crises involving his wife's visa and citizenship difficulties, serious illnesses of the children and discouragements in training because of language handicaps. He is now successfully completing training as an office clerk.

Case H. G.—A 25 year old Mexican was very frightened in the hospital because of frequent small hemorrhages. He was also unhappy because his fiancée's parents refused to allow her to visit him because of his disease. The social worker persuaded the patient to work toward arresting his disease by accepting more complete bedrest and to regain economic status by cooperating in the rehabilitation program. He accepted this and, as success began to manifest itself in both directions, he changed to a congenial individual who encouraged his fellow patients to do likewise. When he became ambulatory, he wrote to his fiancée. This resulted in her parents giving their consent to the engagement of the couple which culminated in a colorful church wedding and assistance in setting up a home by local organizations. The patient, having completed vocational training, is now working as a photographer.

Comments

The number of completed questionnaires represents a satisfactory percentage after so long a period following discharge of the patients. One speculates,

however, on the status of those thirty-five patients not returning answers. The question, therefore, might arise whether the study may not be weighted in one direction. Although a patient's lack of reply to the questionnaire may reflect his medical or rehabilitation failure, sixteen of the thirty-five who did not answer are known to one of the writers to be well and working.

A careful analysis of the failures indicated the need for: (1) a careful and realistic appraisal of the patient's vocational capabilities and temperament with a view to eliminate excessive stresses during his adjustment period; (2) recognition of the patient's financial resources and home situations as well as location of home in relation to training or work area; (3) responsibility residing in one agency to coordinate all resources necessary to carry out the patient's rehabilitation during the post-hospital period, and (4) maintenance of continuity of rehabilitation efforts during the hospital and post-hospital periods by close liaison between the corresponding agencies. Our revised program now fairly well meets these needs.

The following table indicates the proportion of patients who changed their vocational objective from that approved at the discharge board.

TABLE I — POST-HOSPITAL CHANGES IN VOCATIONAL PLANS

Patients	Vocational Objective			
	Same	Related	Different	No Plan
Rehospitalized	3	0	2	1
Dead	2	0	0	0
Retrained, working	18	3	1	0
Still training	17	8	4	0
No training, working	3	3	4	0
In own business	4	3	0	0

Eighteen, changing to related fields, should not be considered failures of evaluations or advisement. Although desirable from the discharging physician's standpoint, it is probably not possible to pinpoint the exact objective until the patient, who perhaps has had limited working experience, can investigate his choice more fully in the outside environment. However, eleven

changed to an entirely different vocational objective because of financial pressures, finding the work or training too strenuous, lack of real interest or unsuitability due to racial prejudices, as in the case of the eight failures. These findings indicate the need for more careful evaluation of these factors before a vocational plan is approved in the hospital. This need appears more evident in those who plan to work shortly after discharge from the hospital and for the men who are not eligible for follow-up program by the Veterans Administration. This is now being accomplished by direct referral from the hospital Social Service worker to the medical social worker of the public health departments. There remains yet a need for closer liaison between the vocational advisement services of the hospital and those of the Veterans Administration Regional Offices or the State Vocational Rehabilitation Service.

Difficulties were encountered in obtaining work or enrollment in a school curriculum immediately after discharge because of the restricted numbers of work or training hours prescribed, usually about half the normal load. This was found particularly in civil service opportunities, municipal training schools and some professional schools. A time interval of six months to two years after the patient reached the diagnosis of arrested tuberculosis was found necessary before the patient secured medical approval to work in some industries and in elementary teaching situations. Such difficulties could be overcome by careful investigation before discharge, by reconsidering the training objective or by planning temporary training or work to fill the time gap. Discharge planning would be facilitated by directing the patient, during his ambulatory phase, to investigate training or work situations on the spot and to reach definite agreement, where possible, with prospective employers or school authorities.

Industry appeared to cooperate fairly well in the rehabilitation of the physically limited. In the instances in which the patients felt that they must conceal

their tuberculous disease to obtain employment, further work must be done in an attempt to help the patient change his attitude in regard to his diagnosis

TABLE 2 — EDUCATION AND VOCATIONAL LEVELS BEFORE AND AFTER HOSPITALIZATION

	Before Hospitalization	After Discharge
Education:		
High School or better	34	65
8th to 11th grade	34	4
Below 8th grade	5	4
Not Known	3	3
Total	76	76
Vocations:		
Now working —		
Unskilled Labor	10	2
Skilled Labor	10	2
Clerical Work	4	6
Technical Work	5	12
Professional Work	2	10
Own Business	3	7
Armed Service	5	0
Total	39	39
Training: (including the five rehospitalized patients)		
Unskilled Labor	5	0
Skilled Labor	5	0
Clerical Work	5	6
Technical Work	7	15
Professional Work	2	12
Armed Service	6	0
No Training	7	2
Deceased	0	2
Total	37	37
GRAND TOTAL	76	76

and to gain his support in interpreting information regarding tuberculosis to his future employer and to the community.

Referring to the fact that twenty-seven of the patients had previously been hospitalized for tuberculosis, thirteen terminating treatment by irregular discharges, it is significant to note that all of these remained in the hospital, during the period studied, to complete treatment. Between the group of eight considered failures and the sixty-eight considered successfully rehabilitated, there was little statistical difference in numbers of those who had terminated a previous hospitalization by irregular discharge. This would seem to show that it is possible to develop insight and understanding even in patients with history of irregular discharge.

On the whole the rehabilitation program was successful in accomplishing its purposes with the great majority of the patients studied. Its place in rela-

tion to medical therapy appears justified. In addition to the accomplishment of its primary aims of returning patients to community and industry without reactivation of tuberculosis, there have been further gains to the community. The educational, social and economic status of the patients have been considerably improved after hospitalization compared with their levels before the illness as is illustrated in the foregoing table.

Summary

Questionnaires were sent to 113 tuberculosis patients who had been discharged from the hospital with arrested pulmonary tuberculosis two to four and one-half years previously. Replies were received to seventy-eight questionnaires. One patient died and one had been

committed to a mental institution.

Seventy-six questionnaires were studied to determine how well the hospital rehabilitation program and discharge planning had served to help the patient regain social and economic competence and to prevent reactivation of the tuberculosis disease.

With few exceptions, the rehabilitation program appeared to have been successful in accomplishing these aims. The failures were analyzed in detail for the purpose of discovering deficiencies of evaluation and pre-discharge planning which may have been determining factors in the patient's failure to make a successful post-hospital adjustment.

Acknowledgement — The authors are grateful to the late Dr. J. Dwight Davis for his inspiration and guidance during the development of this program.

WE WANT TO KNOW ABOUT YOU —

your activities, local and national, are of interest to us. *Remember, what may not be news to you is news to others.* Please send all information before the 15th of the month. The news blank is for your convenience — **send it in today!**

— MEMBERSHIP NEWS —

Archives of Physical Medicine and Rehabilitation

Who?

What?

Where?

When?

Why?

A MESSAGE FROM THE PRESIDENT— Rehabilitation Centers



Wm. Benham Snow

In my last message I discussed the problems surrounding the ancillary technical services which support the practice of Physical Medicine.

This message pertains to the concept and practical establishment of rehabilitation centers.

The idea of the rehabilitation center has come into increasing prominence in the past ten years. The few such centers existent prior to World War II set a pattern which was elaborated by the armed services during the war and reached a high standard in the present programs of the Veterans Administration. On the premise that the good care accorded the veteran is no less needed by non-service connected civilians, it is obvious that more civilian rehabilitation centers should be established.

Despite all that has been written and advice that has been promulgated, the workable pattern for voluntary and private rehabilitation centers still requires definition. These centers may conceivably be anything from a physiatrist with an outpatient setup and adequate personnel to give physical rehabilitation to maximal recovery, to a complete rehab-

ilitation unit equipped for thorough social investigation, psychological testing, psychiatric assistance, and adjustment to disability combined with the physical rehabilitation of the disabled person. In between these two rehabilitation setups there are institutions which are concerned mainly with social and personal adjustment, job training and placement. Other institutions assemble medical technical workers to give progressive physical rehabilitation but supply insufficient daily medical supervision.

Originally, only severely disabled patients reached rehabilitation centers, and then usually by very circuitous routes where chance played a great part in their obtaining such assistance.

There is need for a meeting of the minds to evaluate efficient rehabilitation centers and define the adequacy of their offerings. Rehabilitation centers of various types will gain in efficiency and, it is hoped, be economically operated so that the expense to the patients will be consistent with reduced tension and worry so necessary to recovery from illness.

There is need for education of physicians on the value of total rehabilitation so that patients will be directed to these services at the proper time in their illness. The strongest persuasion to the profession will, of course, be successful rehabilitation of patients, with well defined goals, straight ahead treatment, and prompt termination of treatment with realistic evaluation. Formal education of physicians and medical students along these lines of appreciation is proceeding at a slow but progressive pace. This appreciation will accelerate with observed success of individual, well run and medically supervised rehabilitation centers.

Several Congress committees are considering various phases pertinent to crystallizing these problems of rehabilitation. These are the committees on

Rehabilitation Centers, Program, Advances in Education, Coordination and Integration of Rehabilitation in Geriatrics, and Correlation of Physical Medicine and Psychiatry. The combined effort of these hardworking committees should

advance the understanding, integration, and publicity for rehabilitation centers.

Boe Brulaw Snow

MEDICAL NEWS

Members are invited to send to this office items of news of general interest, for example, those relating to society activities, new hospitals, education, etc. Programs should be received at least six weeks before the date of meeting.

PERSONALS

Col. Benjamin A. Strickland, Jr., was recently elected to membership as a Fellow of the American College of Physicians. — At the monthly meeting of the Central District of the Texas A.P.T.A., Captain David Rubin and Captain Anthony Brittis, San Antonio, Texas, discussed "Rehabilitation of Patients with Physical Disabilities." — Josephine J. Buchanan, Arlington, Va., was a participant in an Institute on Cardiac Rehabilitation sponsored by the Washington Heart Association. — At the national spring conference of the American Academy of Pediatrics, W. A. Selle, Los Angeles, Calif., presented the topic "Physiology of Fever." — Stanley F. Radzyninski, Wadsworth, Kansas, conducted a panel presentation demonstrating the coordination of Vocational Counseling with Physical Medicine and Rehabilitation, at the In-Service Training Seminar for Counseling Psychologists (Vocational) at the Wadsworth VA Center.

Charles Sheard, Rochester, Minn., has been re-elected to serve a term of three years on the board of directors of the National Society for the Prevention of Blindness. — The Riley County Society (Kansas) heard Donald L. Rose, Kansas City, Kansas, speak on "The Conservative Management of the Painful Shoulder." — William J. La Joie, Phoenix, Ariz., was recently elected president of the Arizona Chapter of the Society for the Brain Injured Child. He is also serving on the Medical Advisory Committees of the local chapters of the Muscular Dystrophy Association of America and the National Multiple Sclerosis Society. — Eugene L. Jewett, Orlando, Fla., was guest speaker at

the weekly luncheon meeting of the Orlando Kiwanis Club. He spoke on the progress in the field of polio research. At the 80th annual meeting of the Florida Medical Association, Dr. Jewett presented the scientific exhibit "Uses of the Universal Flange Nail."

George G. Draver, New York, conducted a symposium in Physical Medicine and Rehabilitation at the VA Hospital in Augusta, Ga.; the program consisted of lectures in rehabilitation and cases to illustrate various phases and types of treatment in rehabilitation. — George Morris Piersol, Philadelphia; Florence I. Mahoney, Memphis, Tenn., and Lewis Cohen, Detroit, Mich., attended the meeting of the American College of Physicians recently held in Chicago. — Louis N. Rudin, Ft. Howard, Md., spoke on "Rehabilitation" at a symposium on Rheumatoid Arthritis sponsored by the Maryland Academy of Medicine and Surgery. — With co-sponsors, Odon F. von Werssowetz, Gonzales, Texas, presented the scientific exhibit "Assistive Devices in Rehabilitation of Upper Extremity Disabilities" at the 87th annual session of the Texas Medical Association. — Joseph L. Hollander, Philadelphia, participated in the panel discussion "Uses and Abuses of ACTH and Cortisone" at a meeting of the Baltimore City Medical Society. — "The Proper Use of Physical Medicine as Applied to the Injured Hand" was the topic presented by S. Malvern Dorinson, San Francisco, at the Section on Industrial Medicine and Surgery of the 83rd annual meeting of the California Medical Association. Dr. Dorinson also lectured on "Rehabilitation of the Hemiplegic" at an extension course for general practitioners at the University of California.

At the regular monthly meeting of the Crenshaw Academy of Medicine, **O. Leonard Huddleston**, Santa Monica, Calif., discussed "Modern Concepts of Physical Medicine." — **Herman Bearzy**, Dayton, Ohio, participated in three television broadcasts. TV viewers saw and heard Dr. Bearzy discuss poliomyelitis with a clinical demonstration on rehabilitation technics for polio patients. His appearances were part of the 1954 Polio Drive. He presented the scientific exhibit "Ultrasonics in Medicine" at the meeting of the Ohio State Medical Association. — **C. G. Psaki**, Philadelphia, addressed the graduate staff nurses and senior students of the Chestnut Hill Hospital School of Nursing and Nursing Service. His subject, highlighted with slides and movies, covered the latest concepts of prosthetic devices for upper and lower extremity amputees and cineplasty with the necessary training program. Dr. Psaki and **Robert J. Doman**, Drexel Hill, Pa., are serving on the Rehabilitation Committee of the Industrial Medical Association of Philadelphia. The function of this committee is to advise members of the latest rehabilitation concepts and gather information relative to physical therapy personnel and accepted equipment. — **S. Harry Berns**, New York, recently lectured to Parent-Teachers Associations of two Bronx public schools under the auspices of the Greater New York Chapter of the National Foundation for Infantile Paralysis; he has been appointed Medical Director of the Westchester Cerebral Palsy Association Clinic at Bedford Hills (N.Y.). — **Bruce B. Grynbaum**, New York, has been elected a Fellow of the American Academy of Compensation Medicine.

AMA SECTION ON PHYSICAL MEDICINE AND REHABILITATION

The Section on Physical Medicine and Rehabilitation of The American Medical Association will meet June 22-24, 1954, in San Francisco. The following program is scheduled:

Tuesday, June 22

Business Meeting

Chairman's Address: Factors Influencing Progress in Physical Medicine and Rehabilitation, **Walter M. Solomon**, Cleveland.

Physical Therapeutic Management of the Painful Hip, **Frank H. Krusen**, Rochester, Minn.;

An Effective Comprehensive Program for Geriatric Patients, **Murray B. Ferderber**, Pittsburgh and **Gerard P. Hammill**, Woodville, Pa.;

Therapeutic Use of Cold, **William Bierman**, New York;

Practical Mechanical Devices Used by

Disabled in Activities of Daily Living, **Donald A. Covalt**, New York;

The Present Value of Ultrasonic Diathermy, **Justus F. Lehmann**; **Frank H. Krusen**; **Donald J. Erickson**, and **Gordon M. Martin**, Rochester, Minn.;

Council on Physical Medicine and Rehabilitation: Services for the Practitioner, **Ralph E. De Forest**, Chicago;

Breathing Exercises as an Adjunct in the Treatment of Bronchial Asthma and Pulmonary Emphysema, **S. Malvern Dorinson**, San Francisco;

Rehabilitation Centers: Planning, Administration, Personnel, Finances, **Ralph E. Worden**, Columbus, Ohio;

Plexiglass Splints for Neurological Conditions, **Everill W. Fowlks**, Oswego, Ore.;

The Importance of Scapulo-Humeral Motion in Shoulder Lesions, **Miland E. Knapp** and **J. P. Engel**, Minneapolis.

Wednesday, June 23

Business Meeting — Election of Officers

PANEL ON DEGENERATIVE JOINT DISEASE (OSTEOARTHRITIS), Moderator: **Arthur C. Jones**, Portland, Ore.;

General Remarks (incidence, importance, etiology, pathology, symptoms, signs), **Edward W. Lowman**, New York;

Medical Treatment, **Howard F. Polley**, Rochester, Minn.;

Physical Medicine Rehabilitation Treatment, **Frances Baker**, San Mateo, Calif.;

Surgery, **John J. Loutzenheiser**, San Francisco, Calif.

Thursday, June 24

Backache: Measures That Have Proven Helpful, **Frederic J. Kottke**, Minneapolis;

Basic Principles of Neuromuscular Re-education, **O. Leonard Huddleston**, Santa Monica, Calif.;

The Lower Extremity Amputee — Postoperative Management, **Lt. Col. Raoul C. Psaki**; **Captain Phyllis R. Strobel**, and **Major John J. Keys**, San Francisco;

Physical Medicine Aid in the Care of Multiple Sclerosis, **Morton Marks** and **Joseph Goodgold**, New York;

The Use of Physical Measures in the Diagnosis and Treatment of Facial Paralysis, **Fred B. Moor**, Los Angeles.

Discussors for the papers presented at the June 24 session are **W. Porter Forcade**, San Francisco; **Wm. Benham Snow**, New York; **Odon F. von Werssowetz**, Gonzalez, Texas; **Francis X. Sweeney**, Seattle, Wash.; and **Sherburne W. Heath, Jr.**, Bellevue, Wash.

IMPORTANT CORRECTION

The following corrections should be made to the membership roster which was published in the March 1954 issue of the

ARCHIVES. Dr. Nathan Polmer's Society and Board affiliations were omitted from his membership listing on page 181. Dr. Polmer is both a member in good standing of the American Society of Physical Medicine and Rehabilitation as well as a diplomate of the American Board of Physical Medicine and Rehabilitation. The name of Frank Lehmacher, 16 Central Avenue, Lakewood, New Jersey, should also be added to the roster. The editorial staff regrets any inconvenience to Doctors Polmer and Lehmacher resulting from this oversight.

INTERNATIONAL FEDERATION TO MEET

The meeting of the Executive Committee of the International Federation of Physical Medicine will be held on June 27 at Ostend, Belgium. Joint meetings of the Societe Belge de Physiotherapie and the British Association of Physical Medicine are scheduled and which will include three symposia on pain, on posture and on training in their relation to physical medicine.

COMMISSION RELEASES ACCREDITED HOSPITAL LIST

The Joint Commission on Accreditation of Hospitals released its annual list of fully and provisionally accredited hospitals in the United States, its possessions, and in Canada. Full accreditation was given to 2,920 hospitals and provisional accreditation to 498 hospitals. The Commission is supported by the American College of Physicians; the American College of Surgeons; the American Hospital Association; the American Medical Association, and the Canadian Medical Association.

RECENT PUBLICATIONS BY MEMBERS

Harold Dinkes, "Physical Medicine in Treatment and Rehabilitation of Rheumatic Disease." *Geriatrics*, December, 1953.

F. A. Hellebrandt, "Disability, Rehabilitation and Law of Damages: Implications of Modern Rehabilitation Medicine." *Industrial Medicine and Surgery*, December, 1953.

Robert C. Darling, with co-authors, "Sweat Electrolyte Disturbances Associated with Childhood Pancreatic Disease." *American Journal of Medicine*, December, 1953.

J. L. Hollander, "Intra-Articular Hydrocortisone in Arthritis and Allied Conditions: Summary of Two Years' Clinical Experience." *Journal of Bone and Joint Surgery*, October, 1953.

Sedewick Mead, "Responsibilities and Privileges of the Physiatrist." *Southern Medical Journal*, December, 1953.

David Rubin and Ernest F. Adams, with co-authors, "A Physical Medicine Ward in

an Army Hospital." *United States Armed Forces Medical Journal*, March, 1954.

Donald L. Rose, with co-authors, "The Use of Trypsin in Rheumatoid Arthritis: A Clinical Study." *The Journal of the Kansas Medical Society*, March, 1954.

J. L. Rudd, with co-author, "A Hand Clinic in a Department of Physical Medicine and Rehabilitation." *The Physical Therapy Review*, April, 1954.

Frederic J. Kottke, with co-authors, "Adaptation in Pressor-Receptor Reflex Mechanisms in Experimental Neurogenic Hypertension." *American Journal of Physiology*, December, 1953.

Hans J. Behrend, "Further Light on the Rationale of Physical Medicine Procedures." *New York State Journal of Medicine*, January 15, 1954.

S. Malvern Dorinson, with co-authors, "A Support for Teaching Head Control in Cerebral Palsy." *The Physical Therapy Review*, April, 1954.

Abraham R. Hollender, "Sore Tongue: Diagnostic and Therapeutic Aspects." *The Journal of the Florida Medical Association*, March, 1954.

APPARATUS ACCEPTED

The following information relative to apparatus accepted by the Council on Physical Medicine and Rehabilitation of The American Medical Association is reprinted, with permission, from the March 20, 1954 issue of *The Journal of The American Medical Association*.

Bennett Pressure Breathing Therapy Unit, Model TV-2P: V. Ray Bennett and Associates, Inc., 320 S. Robertson Blvd., Los Angeles 48, Calif.

The Bennett Pressure Breathing Therapy Unit delivers oxygen under positive pressure to a patient but stops the flow when the pulmonary inflation reaches the point of diminished flow; in other words, it is said to be "flow-sensitive." When it is connected to a patient, a slight inspiratory effort on his part, which creates a very slight initial negative pressure of usually less than 1 cm. H₂O, starts the flow of oxygen into his airways. The pressure then builds up to that set by the control pressure adjustment, and the flow continues at whatever rate the lungs are expanding. The unit will continue to maintain this inspiratory phase until the flow rate is reduced to approximately one or two liters per minute or until the flow direction is reversed. This apparatus therefore differs from the "pressure-sensitive" regulators in which the flow continues until inflation results in a specified back-pressure.

The essential part about which the apparatus is built is the flow-sensitive Bennett valve, which is to be attached to a cylinder of

compressed oxygen. The standard accessories are a mask, mask harness, test lung (a bag of about one liter capacity), nebulizer, wrench, screw driver, cleaning brush, and instruction manual. These are included in the shipping weight, which is 7.7 kg. (17 lb.). A carrying case is optional but the "Flex Arm" to support the connections is a standard part of the unit. Packed for shipment the standard equipment makes a package measuring 26 by 55 by 25 cm. (10½ by 22 by 10 in.).

From sources acceptable to the Council evidence was obtained indicating that the apparatus was well made, that it worked as represented by the manufacturer, and that it was useful in the treatment of certain types of dyspnea and apnea and in the administration of aerosol therapy.

The Council on Physical Medicine and Rehabilitation voted to include the Bennett Pressure Breathing Therapy Unit, Model TV-2P with the stipulation that its use be limited to medical treatments under the direction of a qualified physician.

BOOKS RECEIVED

Books received are acknowledged in this column as full return for the courtesy of the senders. Reviews will be published in future issues of the journal. Books listed are not available for lending.

Hope and Help in Parkinson's Disease by John C. Button, Jr.; Vantage Press Company, New York.

Black's Medical Dictionary compiled by John D. Comrie and William A. R. Thomson; The Macmillan Company, New York.

1954 Medical Progress edited by Morris Fishbein; The Blakiston Company, Inc., New York.

Psychosomatic Case Book by Roy R. Grinker and Fred P. Robbins; The Blakiston Company, Inc., New York.

Educating Physical Therapists to Meet the Challenge of the Future by Frances A. Hellebrandt; Stipes Publishing Company, Campaign, Ill.

Facial Deformities and Plastic Surgery by Frances Cooke MacGregor; Charles C. Thomas, Springfield, Ill.

Progress in Fundamental Medicine edited by J. F. A. McManus; Lea & Febiger, Philadelphia.

Metabolic and Toxic Diseases of the Nervous System edited by H. Houston Merritt and Clarence C. Hare; The Williams & Wilkins Company, Baltimore.

The Psychiatric Aide by Alice M. Robinson; J. B. Lippincott Company, Philadelphia.

Headache by Robert E. Ryan; The C. V. Mosby Company, St. Louis, Mo.

Professional Preparation in Health, Physical Education, and Recreation by Raymond Albert Snyder and Harry A. Scott; McGraw Hill Book Company, Inc., New York.

Science and Man's Behavior: The Contribution of Phylobiology by Trigrant Burrow; Philosophical Library, Inc., New York.

Financing Hospital Care in the U.S. by Commission on Financing of Hospital Care; The Blakiston Company, Inc., New York.

Neurosurgery by Gilbert Horrax; Charles C. Thomas, Springfield, Ill.

Symposium on the Mechanism of Inflammation by Gaetan Jasmin and Andre Robert; ACTA, Inc., Montreal, Que., Canada.

Orthopädische Konstruktionen: Arbeiten aus der orthop. univ. Poliklinik München, etc. by Prof. Dr. Franz Schede; Grune & Stratton, Inc., New York.

Cure Your Nerves Yourself by Louis E. Bisch; Wilfred Funk, Inc., New York.

Third Annual Report on Stress 1953 by Hans Selye and Alexander Horava; ACTA, Inc., Montreal, Que., Canada.

Wonders of Modern Medicine by Steven M. Spencer; McGraw Hill Book Company, Inc., New York.

Textbook of Physiology: The Activities of the Living Body by Caroline E. Stackpole and Lutie Clemson Leavell; The Macmillan Company, New York.

The Doctors Jacobi by Rhoda Truax; Little, Brown and Company, Boston.

Sources of Information and Unusual Services: A Guide to Organizations and Agencies by Jewel Alexander; Informational Directory Company, New York.

Treatment of Toxic Goiter with Radioactive Iodine by Lindon Seed and Theodore Fields; Charles C. Thomas, Springfield, Ill.

The Sex Paradox by Isabel Drummond; G. P. Putnam's Sons, New York.

Causality in Natural Science by Victor F. Lenzen; Charles C. Thomas, Springfield, Ill.

Histology by Roy O. Greep; The Blakiston Company, Inc., New York.

The Adaptive Chin by E. Lloyd DuBrul; Charles C. Thomas, Springfield, Ill.

Annual Review of Physiology Vol. 16 edited by V. E. Hall; Annual Reviews, Inc., Stanford, Calif.

The Cutaneous Manifestations of Systemic Diseases by John Godwin Downing; Charles C. Thomas, Springfield, Ill.

Michael Servetus: A Translation of His Geographical, Medical and Astrological Writings with Introductions and Notes by Charles Donald O'Malley; American Philosophical Society, Philadelphia.

Dizziness: An Evaluation and Classification by David Downs DeWeese; Charles C. Thomas, Springfield, Ill.

Endogenous Endocrinotherapy Compendium by Jules Samuels; N. V. Cyclocoop, Amsterdam, Holland.

PHYSICAL MEDICINE ABSTRACTS

After-Care of Poliomyelitis. A Clinical Experimental Investigation. P. A. Stensrud.

Nord. med. 49:15 (Jan. 2) 1953.

A series of paretic and some normal extremity muscles were examined in Kidd's sling under standard conditions. The concentric form of active contraction was used. A rest period of five to ten minutes proved sufficient for restitution of the muscles that had been exercised to the fatigue point. Optimal response was seen with two sessions daily, each comprising about ten contractions. Prior application of hot packs for ten minutes increased the working capacity of the muscles. Too vigorous resistance exercises (De Lorme's progressive resistance exercises) may overstretch the muscles and prevent their restitution.

Avulsion of the Tendon of the Subscapularis Muscle. Emil Hauser.

J. Bone & Joint Surg. 36-A:139 (Jan.) 1954.

According to statistics the subscapularis muscle is seldom injured. Tears of this muscle may be observed during operation for repair of the supraspinatus tendon.

The author reports two cases of avulsion of the subscapularis with recurrent dislocation of the shoulder. In each case, the muscle was found to be almost completely avulsed near the insertion on the humerus.

In the repair of the injury, the subscapularis tendon was drawn across the bicipital groove beneath the biceps tendon, and fixed with mattress sutures into a slot cut in the humerus lateral to the bicipital groove. In one case the result was excellent, although in the other subluxation could still occur with the shoulder relaxed, and in the position of abduction and external rotation.

The opinion is expressed that in the repair of recurrent shoulder dislocation, associated with avulsed subscapularis, the repair should be combined with a shortening of the capsule similar to the Putti-Platt operation or by the Bankhart procedure.

Cardiovascular Effects of Exercise in the Normal and Cardiac. M. Lowenthal; J. S. Tobis, and K. Harpuder

Brit. J. Phys. Med. 17:13 (Jan.) 1954.

This paper reviews the circulatory effects of exercise in the normal and the cardiac patient, and presents the findings to give a better understanding of the prescription of exercise. The primary problem in exercise is an increased requirement of oxygen in the exercising muscle which may exceed the resting needs by as much as twenty to thirty times. Increased cardiac output and extraction of oxygen take care of the demand in the normal. In the supine position the increased flow of the peripheral blood is apparently due almost entirely to the higher cardiac output, while in the erect position redistribution of blood takes place with greater ease, thus lessening the load upon the heart.

The well-compensated cardiac patient presents no special problem during exercise. The decompensated cardiac patient has a cardiac output which is close to the maximum but is still below the normal level under ordinary circumstances, and he cannot cope with the additional stress imposed by exercise. Exercise in these latter cases, therefore, should be prescribed after careful observation of the patient. Extra strain caused by environmental temperature changes, emotional stress, or the post prandial state should be kept at a minimum. The factors involved in training patients need additional study.

The Systemic Lesions of Malignant Rheumatoid Arthritis. B. Bevans, et al.

Am. J. Med. 16:197 (Feb.) 1954.

There is clinical evidence that valvulitis and other stigmata of rheumatic heart disease are infrequent in rheumatoid arthritis except when a straightforward history of rheumatic fever can be obtained. This article reports two cases of active rheumatoid arthritis whose fulminating clinical course was characterized by pleurisy and pericarditis.

The subjects were female patients, ages 52 and 46, who had had severe prolonged rheumatoid arthritis. They had received cortisone for a long period of time. At autopsy, widespread lesions of the viscera, differing from those seen in patients dying with rheumatic fever, were found. There were necrotic and granulomatous lesions in all stages of evolution in the pleura, pericardium, myocardium, endocardium, diaphragm, synovia, and in the kidneys and lung. The primary lesion was fibrinoid necrosis of small blood vessels. Coalescence of several of these injured vessels and the inflammatory response resulted in a lesion indistinguishable from that of rheumatic nodules.

Evidence is presented that there is a malignant form of rheumatoid "arthritis" which is a systemic disease. It seems entirely probable that the high incidence of rheumatic valvulitis reported at post mortem in rheumatoid arthritis represents the healed stage of the lesions which were encountered in the cases described.

The Use of Heparin with Testosterone in Parkinsonism. S. J. Weinberg.

J. Gerontol. 9:43 (Jan.) 1954.

The present status of treatment of Parkinsonism is unsatisfactory. It is limited largely to drugs having a palliative effect upon certain features of the condition. Relief of spasticity has been achieved at times; at other times the mental depression so often present is reduced. However, no specific or totally satisfactory symptomatic treatment for Parkinsonism has been found up to the present time.

It was assumed that arteriosclerotic disturbances might be associated with a catabolic action in the lenticular-hypothalamic area and that there may be further disorders of the extra-pyramidal-hypothalamic-endocrine system. Therefore a plan of treatment was devised which was hoped would favorably influence the vascular supply of these regions. Theoretically, the heparin would facilitate removal of lipoids from the arteriosclerotic vascular wall, increase the blood supply to cells in the substantia nigra, corpus striatum, other basal ganglia, and hypothalamus. Long-acting testosterone was given to combat weight loss from effects of inadequate anabolic hormones.

Seventeen male patients, under heparin and testosterone therapy, were observed for six months. The patients gained weight and strength and exhibited marked amelioration of sialorrhea. However, the tremor, restlessness, and rigidity were not consistently retarded.

Phenylbutazone (Butazolidin) in Gout. W. C. Kuzell, et al.

Am. J. Med. 16:212 (Feb.) 1954.

The therapeutic effect of phenylbutazone in gout appears to be more beneficial and selective than that in other painful musculoskeletal disorders. Major improvement or complete remission was observed in eighty-four per cent of 200 patients with acute gout or chronic gouty arthritis. Males responded more favorably than did females. Acute gout was more amenable than chronic.

In a study of 408 patients with painful musculoskeletal disorders other than gout, the beneficial effect of phenylbutazone was found to be less in patients who had elevated serum uric acid than in those with normal levels. This suggests that reduction of serum uric acid may not be the most important pharmacologic action of this drug.

Intramuscular phenylbutazone relieves pain, swelling, and erythema in the typical case of acute gout within several hours, in many instances. The relief experienced by most patients exceeded in degree and rapidity that which they had previously obtained with colchicine and/or hormone therapy. A maintenance dosage of 100 to 600 mg. of the drug daily, in chronic gouty arthritis, greatly reduced the attack rate, severity, and duration of acute exacerbations. Undesirable effects were less severe in gout than in other painful musculoskeletal disorders and usually occurred early in treatment. Twenty-six per cent of 200 patients with gout had toxic side effects and discontinuance of the use of the drug was warranted in seven per cent. Edema and nausea were the most common side effects.

Studies in Objective Evaluation of the Patient with Cardiovascular Disease for Rehabilitation and Vocational Guidance. Joseph G. Benton.

Brit. J. Phys. Med. 17:15 (Jan.) 1954.

Objective methods of studying rehabilitation in cardiovascular subjects before, during, and after treatment have shown progress recently. There are two major categories of special interest: (1) overt disability (hemiplegia from cerebral vascular accidents) with underlying systemic cardiovascular disease, and (2) masked disability, cardiac limitation from valvular and/or myocardial disease resulting in signs of decompensation on activity.

Results of treatment of carefully selected hemiplegic patients in the first category showed that a program of rehabilitation increased the activities of daily living over 135 per cent as compared with a control group which received no retraining. The methods

ogy involved serial determinations of muscle strength, passive range of motion (goniometric), and activities of daily living.

Oxygen consumption was studied in fifty patients with valvular or myocardial damage in functional classification I through III. It was found that level and graduated stair walking required an energy cost two to twenty-four times above the resting metabolic rate. Work was considered moderate when energy cost was three times the basal metabolic rate, and strenuous when the cost was eight times the basal rate. Data indicated that kitchen activities for the average housewife with cardiac disease should be limited to short periods of work requiring not more than five times the energy cost necessary in the resting state. Qualitatively, ballistocardiography shows high correlation between the normal resting ballistocardiogram and ability to do work twenty-four times above the resting level.

Clinical Implications of Recent Studies on Cerebral Circulation of Man. H. A. Shenkin, and P. Novack.

A.M.A. Arch. Neurol. & Psychiat. 71:148 (Feb.) 1954.

The authors used the nitrous oxide method of Kety and Schmidt to determine quantitatively the cerebral blood flow while simultaneously measuring blood pressure, oxygen content of arterial and jugular blood, and calculated the resistance offered to blood passing through the cerebral vessels and oxygen consumption of the brain in over fifty cases varying from 38 to 86 years of age.

Arteriosclerosis in absence of hypertension, or hypertension unaccompanied by arteriosclerosis was observed not to alter materially or reduce cerebral blood flow or oxygen consumption, although an increase in cerebrovascular resistance occurred in the latter condition. When hypertension and arteriosclerosis coexisted, however, a more severe and diffuse type of arteriosclerosis occurs, not present in either condition alone.

Inhalations of five per cent CO_2 by raising the partial pressure of this gas in the blood, according to Kety and Schmidt, dilates the cerebral vessels reducing the resistance and increasing the cerebral blood flow by approximately forty per cent in normal young adults. CO_2 had little effect in increasing blood flow in persons with arteriosclerotic cerebral vascular disease without hypertension, as the vessels were presumably rigid or already maximally dilated. Neither CO_2 nor other vasodilating agents tested were effective in combating cerebral arteriosclerosis unless vasospasm was present. In persons with both arteriosclerosis and hypertension, however, inhalations of CO_2 resulted in reduction of cerebral vascular re-

sistance, showing that arteriosclerosis itself does not abolish cerebral vascular reactivity.

Although xanthines, caffeine, sodium benzoate, aminophylline, nicotinic acid, prisoline, papaverine, and CO_2 inhalations all have been advocated as effective cerebral vascular dilating agents, studied by this direct method very few revealed any real ability to dilate cerebral vessels and increase blood flow. Raising the CO_2 content of the blood proved to be the most effective method, and papaverine in adequate dosage was shown to have a limited value in causing cerebral vasodilatation without drastically reducing the systemic blood pressure.

Proven sympathetic innervation of vascular tone in cerebral vessels has resulted in attempted blocking of these fibers to increase cerebral circulation following cerebral thrombosis and embolism. Bilateral stellate ganglionectomy which has exerted definite cerebrovascular relaxation, was shown to be most effective in those with initially slow cerebral blood flows and high cerebrovascular resistance, and was of greatest effect in patients with both hypertension and arteriosclerosis.

Changes in cerebral blood flow causes similar changes in cerebral spinal fluid pressure it was shown, which explains the syndrome of cerebral hypotension often seen after surgery for relief of subdural hematoma or internal hydrocephalus. It was also shown that the increased intracranial pressure can be reduced by restoring cerebral blood flow at least temporarily by intravenous administration of 150 cc. of fifty per cent dextrose. This reduces the cerebrovascular resistance by lowering the blood viscosity and diluting the circulating blood, lowering the arterial oxygen content and resulting in no change in oxygen delivery to the brain, although it may have a beneficial effect by removing metabolic products not dependent on hemoglobin transport.

Facilitation and Inhibition of Gamma Efferents by Stimulation of Certain Skin Areas. E. Eldred, and K. E. Hagbarth.

J. Neurophysiol. 17:59 (Jan.) 1954.

In innervation of muscles of a cat's hind-limb alpha efferent fibers innervate regular muscle fibers, while gamma nerve fibers excite the intrafusal muscle fibers, and thus greatly modify the afferent discharge of the muscle spindles.

If the skin over the muscle is pinched, there occurs a discharge of impulses in the efferent alpha fibers to the muscle so that a contraction is facilitated. However, relaxation of the muscle occurs when skin over its antagonist is stimulated.

In the central stump of a severed nerve the alpha spikes are seen in the myograph

to be of greater amplitude than the gamma spikes. When activity at the peripheral stump of a nerve is recorded electrically, gamma fiber activity can be inferred by observing the parallel changes in afferent discharge from the muscle spindle.

Using decerebrate cats, increase in alpha spikes is shown in muscle nerve to the gastrocnemius when skin over the muscle is irritated, but decrease when the foot is stimulated. Excitation and inhibition of gamma impulses is noted during the same types of stimulation. Gamma discharges are much easier to elicit than the alphas.

During sampling from the peripheral stump of an afferent nerve of the gastrocnemius, increase in the discharge occurs on stimulation of the dorsum, and decrease on stimulation of the foot. Pause in the discharges during a muscle contraction proves that it is an afferent fiber from a muscle spindle.

Stimulation of skin over the dorsum of the leg inhibits alpha efferent impulses to the tibialis anterior. Gamma fibers respond the same as the alpha fibers to skin stimulation but with a lower threshold.

Thus, gamma efferent activity may be used as an index of reflex skin effects being more sensitive than alpha activity. Since the afferent discharge of muscle spindles facilitates alpha motoneurons, any facilitation of gamma motoneurons as through the skin reflex, could thus indirectly facilitate the alpha motoneurons because of the modifying effect of gamma discharges in the muscle spindles.

Some Physiologic Considerations of the Therapeutic Action of Ultrasonics. Disraeli Kobak.

Am. J. Phys. Med. 33:21 (Feb.) 1954.

When a piezoelectric quartz crystal is coupled with a high frequency alternating circuit, the energy released will be in the form of sound waves with the same periodicity as the initial high frequency oscillation. The mechanical action of these sound waves has been shown to have thermoelectric, catalytic, and biochemical effects within the field of radiation.

The term ultrasonic means that the frequency of the sound waves is above the range of human hearing. The wave length in air is 0.6 to 1.6×10^{-4} cm., and 2.4 to 6×10^{-4} cm. in liquids, and 8 to 20×10^{-4} cm. in solids.

Ultrasound has been confused with short wave diathermy because of its deep heating effect similar to the latter modality. There is considerable argument concerning the thermal versus mechanical action of ultrasound. Many of the findings reported from experimental work cannot be considered valid in clinical medicine because of the doses and

methods used. These high doses produced inflammatory hyperplastic and degenerative changes with neurocirculatory disturbances. Many of the studies conducted abroad point to a neurotrophic factor in the response of human tissue.

The dose has been defined as the kinetic energy that passes through a unit area in a unit of time expressed as ergs or watts per square centimeter. Humans are protected against damaging effects of dangerous doses by presence of pain sensibility.

Doses of high dimension will diminish metabolic activity and suppress healing power. The ideal dose should have an analgesic and spasmolytic effect without any bruising sensation or periosteal pain. It is possible to produce nutritional responses in diseased organs by the use of local and remote treatment of the region. The spinal nerve roots supplying the area are sonated as well as the area where the effect is desired, or the appropriate Head-zone. Some favor treatment of the Head-zone rather than the spinal nerve roots, but both sides agree that the neural effect of ultrasound is important in the relief of pain.

The effect on the autonomic system is considered important, and collapse of cardias has been reported following sonation over the superior cervical ganglia. Stuhlfauth suggests "that the therapeutic effect of sonation is largely conditioned by the state of the autonomic nervous system." The neurotrophic effect of ultrasound is one of the strongest weapons of physical medicine against disease.

The effect of ultrasound on lung volume through neural effect on lung musculature, and on gastric secretion by sonation over T7 - T9 may open up new avenues in the therapeutics of pulmonary tuberculosis and gastrointestinal disorders.

Circulatory Responses to Intermittent Positive and Alternating Positive-Negative Pressure Respirators. James V. Maloney, Jr., and Stanley W. Handford.

J. Appl. Physiol. 6:8 (Feb.) 1954.

A comparison of breathing machines for purposes of artificial respiration is made. The comparison concerns the machines which produce intermittent positive pressure and the machines which produce a period of positive pressure alternating with a period of negative pressure during expiration. The effects of the two respirators on the cardiac output and blood pressure were compared. Neither type of machine altered the blood pressure or cardiac output significantly in the intact animal. In the presence of respiratory failure or circulatory embarrassment, the positive-negative respirator maintained the cardiac output and blood pressure while the intermittent positive pressure respirator

produced a severe reduction in the cardiac output and a drop in blood pressure and in some animals caused early death by severe depression of the circulation. The cardiac output and blood pressure appears to vary with the mean airway pressure during the respiratory cycle, rather than with any particular pressure wave form. When positive pressure is applied to the lungs a certain portion of this pressure is transmitted to the great veins and the venous return to the heart is impeded. The intact individual has numerous compensatory mechanisms which will come into play to re-establish the venous return. Motor paralysis and loss of motor control tends to prevent these mechanisms from exerting their effect and under these circumstances the intermittent positive pressure breathing may cause a reduction in venous return, cardiac output and blood pressure. The positive-negative pressure respirator may impede venous return during the inspiratory phase but also will aid venous return during the expiration phase and, consequently, circulatory depression does not occur. This latter type respirator is distinctly superior during respirator failure or circulatory embarrassment, since it maintains an adequate cardiac output and blood pressure.

Precipitating Factors in Venous Thrombosis. J. C. Paterson, and J. McLachlin.

Surg., Gynec. & Obst. 98:96 (Jan.) 1954.

Careful evaluation of the current theories of etiology of bland non-infective venous thromboses was attempted by the authors with actual pathologic demonstration of the thrombus in serial sections of the veins of the lower extremities in 165 fatalities among middle aged and elderly patients autopsied at their hospital, seventy-two patients or forty-two per cent of which harbored definite thrombi.

Lesions which might conceivably be related to the tendency to thrombosis were carefully examined, and included inflammatory infiltration of the vein wall, degree of phlebosclerosis, vascularization and hemorrhage of the intimal layer, and atheromatous degeneration or calcification. Results of these morphologic studies were so conclusive that the authors felt that they could state categorically that the theory of local injury or disease of the vein wall, of an obvious type, plays no part in precipitation of bland thrombi in the veins of the lower extremities.

Many substances when present in abnormal amounts have been felt to cause bland venous thrombosis by altering its coagulability. Blood for these studies was obtained twice weekly antemortem on all seriously ill patients in the hospital, and results later compared with the pathologic findings at autopsy.

The anti-thrombin test of Kay and Ochsner appeared to have no value in predicting incipient venous thrombosis under ordinary conditions. The fibrinogen B level which has also been claimed to reflect prethrombotic tendency, proved to have frequent false positives and true positives so rarely as to be impractical. The average blood level of fibrinogen was lower in the thrombotic group than in the non-thrombotic group, distinctly against the opinion that fibrinogen increased in a number of pathologic conditions leading to thrombosis. Alpha tocopherol, considered by many to be a potent anti-thrombin, was shown to have no obvious effect in altering venous thrombosis, and results were not significant. The effectiveness of blood fibrinolysis in resolving thrombi in veins was not impressive once formed, but they may play a role in the fragility of formed thrombi and possible production of pulmonary emboli. Blood platelet counts did not appear of any real value in predicting incipient venous thrombosis, although the number in their series was too small for conclusive evidence.

Stasis of blood in veins, and in other circulatory channels, has long been suspected as a major precipitating factor in thrombosis. Elaborate prophylactic measures have been developed to prevent venous stasis in the lower extremities to avoid thrombosis. Thrombi found at autopsy on serial sections appeared to originate in those areas where stagnation was most likely to occur, usually within the cul-de-sac of the valve pockets. These anatomic autopsy findings would appear to indicate the theory of venous stasis as the major precipitating cause of bland non-infective thrombosis to be correct, although it is conceded that local vein wall injury or altered blood coagulability may operate in certain exceptional cases. To incriminate further venous stasis definitely as the cause of phlebothrombosis, it would be necessary to make determinations of blood flow in the legs during life, and then correlate these findings with the presence or absence of venous thrombi at autopsy. Conclusion is that prophylaxis of venous thrombosis in the lower limbs depends on efficient venous return from these parts, both pre and post-operatively.

**HAVE YOU JOINED THE
MEMBERSHIP DRIVE?**

BOOK REVIEWS

The reviews here published have been prepared by competent authorities and do not necessarily represent the opinions of the American Congress of Physical Medicine and Rehabilitation and/or the American Society of Physical Medicine and Rehabilitation.

YOUR ARTHRITIS: WHAT YOU CAN DO ABOUT IT. By *Alfred E. Phelps, M.D.* Second edition. Cloth. Price, \$3.00. Pp. 192, with illustrations by James Macdonald. William Morrow & Company, Inc., 425 Fourth Ave., New York 16, 1953.

This book is the second edition which in itself indicates the popularity with which it has been received. The author has revised this work and expanded it to include a discussion of the new drugs such as cortisone, hydrocortisone and ACTH and evaluates the results obtained.

The chapter entitled "A Brighter Future for Arthritics," discusses research in arthritis as well as the accomplishments of the Arthritis and Rheumatism Foundation.

This book is written primarily for the layman and is designed to assist the doctor in the care of the rheumatic patient. It should give the patient a better understanding of his disease and also give some helpful advice and details which the busy doctor might not explain as fully as this text. It is an excellent book to be used by patients with arthritis.

CLINICAL APPLICATIONS OF SUGGESTION AND HYPNOSIS. By *William T. Heron, M.A., Ph.D.*, Professor of Psychology, University of Minnesota, Minneapolis. Second edition. Cloth. Price, \$3.75. Pp. 137. Charles C. Thomas, Publisher, 301-327 E. Lawrence Ave., Springfield, Ill.; Blackwell Scientific Publications, Ltd., 49 Broad St., Oxford, England; Ryerson Press, 299 Queen St., W., Toronto 2B, 1953.

This small monograph is strictly for professional use. It does not attempt to make an exhaustive review, nor to discuss psychotherapeutic possibilities. In simple language the present concepts of hypnosis are explained. The usual methods of induction are described and the principles of posthypnotic suggestions set forth. The use of hypnosis with normal people for purposes of anesthesia is the chief clinical application discussed, particularly in relation to dental procedures. Case histories are included. A short bibliography is appended for those interested in studying the subject in greater detail.

NERVOUS TRANSMISSION. By *Ichiji Tasaki, M.D.* Cloth. Price, \$7.50. Pp. 164, with 77 illustrations. Charles C. Thomas, Publisher, 301-327 E. Lawrence Ave., Springfield, Ill.; Blackwell Scientific Publications, Ltd., 49 Broad St., Oxford, England; Ryerson Press, 299 Queen St., W., Toronto 2B, 1953.

This monograph sets forth a series of experiments on the electrical activity of single motor nerve fibers of the toad. It is made possible by use of microtechnics of dissection, which are largely original. Transmission is shown to occur by spread of electrical activity from one node of Ranvier to another.

The text is documented and illustrated with laboratory results in the form of photographs and graphs. Mathematical explanations are at a minimum, and the descriptive language is unusually simple and clear for so intricate a subject.

This is a reference text of value for laboratory workers in this special field of neurophysiology. It is an excellent example of basic research on which the specialty of Physical Medicine looks for a firm foundation, although clinical applications are not yet apparent.

REHABILITATION OF THE OLDER WORKER. Edited by *Wilma Donahue, Ph.D.*, *James W. Rae, Jr., M.D.*, and *Roger B. Berry*. With a foreword by *Everett J. Soop*. Cloth. Price, \$3.25. Pp. 200. University of Michigan Press, Ann Arbor, 1953.

This work represents the fourth of the now familiar annual series of conferences on gerontologic problems presented at the University of Michigan. This volume covers rehabilitation of the handicapped worker over forty years of age. Lectures presented at these conferences have been published in three volumes: *Living Through the Older Years*, *Planning the Older Years*, and *Growing in the Older Years*.

A comprehensive approach to the many problems of rehabilitation of the older worker is presented in ten chapters under the editorship of Wilma Donahue, Ph.D., chairman of the division of gerontology, Institute for Human Adjustment; James W. Rae, Jr., M.D., professor of physical medicine, and Roger B. Berry, University of Michigan.

John L. Thurston, deputy administrator of the Federal Security Administration, discusses the work of the Office of Vocational Rehabilitation and other social agencies which may provide assistance in rehabilitation. Dr. Howard A. Rusk, chairman of the Department of Physical Medicine and Rehabilitation, New York University-Bellevue Medical Center, describes the magnitude of the problems of chronic disease and aging. Dr. Frank H. Krusen reviews the history and progress of physical medicine and rehabilitation since World War I. Dr. Lionel Z. Cosin, clinical director of the geriatric unit, United Oxford Hospitals, Oxford, England, describes a program of geriatric rehabilitation in operation in England.

Four chapters are devoted to conference board hearings or round-table discussions on the medical, psychosocial and economic aspects of rehabilitation, employment and placement, and rehabilitation services and programs. Each panel was composed of a different group of experts, and the material is presented very well, in an informal manner.

Dr. James W. Rae provides a chapter describing physical medicine for many of the diseases which produce chronic disabilities.

The final chapter is a summary of the problems and recommendations as outlined in the conferences.

It is fitting that an annual geriatric conference should be devoted to rehabilitation, because of the growing realization of the needs in this field. The authors have been able to include all the important information presented at this conference. It is a valuable contribution to the field of geriatrics.

THE TROUBLED MIND. A Psychiatric Study of Success and Failure in Human Adaptation. By *Beulah Chamberlain Bosselman, M.D.*, Clinical Associate Professor of Psychiatry, University of Illinois Medical School. Cloth. Price, \$3.50. Pp. 206. The Ronald Press Company, 15 E. 26th St., New York 16, 1953.

Dr. Bosselman, a practicing psychiatrist and psychoanalyst, has stated in the preface that "success and failure are relative concepts, varying according to the individual's expectations of himself and the demands society makes upon him. It is obvious, however, that the person who struggles with a sense of defeat, finds himself reacting in ways that often become progressively more unrealistic and inefficient. His disorganized attempts at adaptation then become 'symptoms,' which vary from slight, casually accepted disturbance of function to the bizarre manifestations of neuroses and psychoses." The author has divided her book into three parts. The first deals with the problem of adaptation, the second with adaptations that fail, and the third with the problem of treatment.

Dr. Bosselman has presented in a clear and readable style, in part I, chapters on (1) infancy, the attainment of self-realization; (2) childhood, love and hate in close interpersonal relationships; (3) later childhood: adaptation within the peer group; (4) adolescence: transition into maturity, (5) maturity: adequacy and overflow; (6) involution and old age: the problem of self-acceptance; and (7) character formation. In part II there are chapters on (1) adaptations unrealistic and inefficient and (2) neurosis and adaptation by distortion and denial: psychosis. Part III discusses the agencies of health and presents suggestions for further reading. The careful description of psychologic development from infancy to old age in part I lays the basis for the explanation of failures of adaptation described in part II and the methods of treatment described in part III.

This is a clear and logical discussion of psychiatry which will be of interest to any intelligent layman as well as to medical practitioners who are not specialists in psychiatry. It is refreshing to find that the author recognizes the importance of the broader education of parents, general practitioners of medicine, psychologists, psychiatric social workers, teachers and ministers in managing the psychiatric problems which face everyone during various stages of life. The final section on the role of the psychiatrist will give the average reader a better understanding of the work of the psychiatrist. This is a sound book, and well worth reading.

PHYSICAL MEDICINE AND REHABILITATION. Edited by *Basil Kiernander, M.B., B.S., M.R.C.P., D.M.R.E., D.Phys.Med.*, Director, Physical Medicine Department, Hospital for Sick Children, Great Ormond Street, London, and Royal National Ear, Nose and Throat Hospital, Civilian Principal Specialist in Physical Medicine, Royal Air Force. With an Introduction by The Rt. Hon. Lord Horder, G.C.V.O., M.D., F.R.C.P., President, British Association of Physical Medicine. Cloth. Price, \$12.75. Pp. 610, with illustrations. Charles C. Thomas, Publisher, 301-327 E. Lawrence Ave., Springfield, Ill., 1953.

This book is a timely comprehensive text on the subject of rehabilitation. The editor has gathered the writings of the most authoritative workers on both sides of the Atlantic. There is present a certain amount of repetition which emphasizes the uniformity of thought expressed by the contributors. In the several chapters dealing with rehabilitation, each writer reveals the importance of understanding the many problems of the chronically ill and the injured worker. Not only are the problems discussed, but the factors in their management are considered. Medical rehabilitation is shown to be a "philosophy of living, an attitude of mind on

the part of the medical profession and public alike."

The opening chapters deal in detail with locomotor anatomy and physiology. A chapter on neuromuscular disorders includes diagnostic methods and treatment. The discussion of qualitative and quantitative electrical tests is alone worth the cost of the book. In addition, the chapters on geriatrics, hemiplegia, and rheumatic diseases are outstanding.

The book is well written. There are a number of well chosen diagrams and illustrations. Each chapter has its own bibliography. The book is highly recommended to all physicians as well as to the psychiatrists.

GROUP WORK WITH THE AGED. By Susan H. Kubie and Gertrude Landau. Cloth. Price, \$3.50. Pp. 214. International Universities Press, Inc., 227 W. 13th St., New York 11, 1953.

On January 7, 1954, Dr. Chester F. Keefer, Special Assistant to the Secretary of Health, Education and Welfare in our Federal Government, told the New York Academy of Medicine, "Chronic diseases have displaced the infections as the number one challenger in the field of public health." Because of the increasing importance of the chronic diseases among our rapidly aging population, all physicians should be referring to such books as this one, *Group Work With the Aged*. This volume describes a pioneering effort to develop a satisfactory Day Center where aged persons who were "hapless victims of indifference and neglect" might achieve some measure of happiness and social adjustment. The credo of its founder, Harry A. Levine, is that "creative energy is ageless."

The book is primarily a social and psychologic study of the problems encountered over a period of nine years in the organization of this center. It is a fascinating record of achievement. There are fourteen chapters: (1) Introduction; (2) Beginnings; (3) Self-Government; (4) Programming; (5) Woodwork and Painting; (6) Poetry; (7) Birthday Parties; (8) Music; (9) Dramatics; (10) The Non-Participating Members; (11) Attitudes, Group Learning; (12) Discussion Groups; (13) Terminal Years, and (14) Counselling.

It is pointed out that one of the major problems of the aged is their progressive isolation from the community. The special value of group work is stressed and a description is given of the methods employed for enriching the experience and stimulating the continuation or renewal of the growth of the participants. Arts, crafts, dramatics, discussion groups and other organizational activities are described. Numerous, interesting conclusions are reached. For example, with regard to painting, the authors have concluded that "it would seem that painting is

one of the least social activities, yet in reviewing the painting at the Center, the interaction of the participants was a constant and important factor."

Another interesting conclusion is: "Throughout the ordinary week, it is often clear that the Center serves as a substitute for the larger community in which the older person no longer has a satisfying place." With regard to music, the authors stated: "There have been moments when it produced group effects that seemed almost magical in their speed and completeness; when its power to change moods by evoking emotion, lifted a room full of people out of their personal dissatisfactions into sudden response and harmony."

Dramatics "increased self-confidence, the ability to learn, to carry through prolonged cooperative effort; it created relationships, and finally, it carried the participants beyond the confines of their protected environment" to face the outside world again. The authors concluded that in discussion groups "the larger import of a contribution could be pointed up and concepts introduced which link each speaker's comments."

This book is recommended to all physicians interested in problems of the aged and will be of special interest to social workers and psychologists who deal with aged persons.

DESIGN AND CONSTRUCTION OF GENERAL HOSPITALS. By U. S. Department of Health, Education and Welfare, Public Health Service. Cloth. Price, \$12.00. Pp. 214, with illustrations. F. W. Dodge Corp., 119 W. 40th St., New York 18; in collaboration with Modern Hospital Publishing Co., 919 N. Michigan Ave., Chicago 11, 1953.

The book, as the title indicates, is a collection of data to be used by architects, hospital administrators and by both architects and hospital administrators when in the process of planning a new hospital unit. The data is the result of extensive research made by personnel in the various departments of the United States Public Health Service with cooperation from other outside associations.

The book is divided into four sections as follows:

1. Schematic Plans—floor plans that show orientation of elements in various sizes of hospital units; these are of great help to the architect in determining the ever important traffic flow.

2. Design and Construction—detailed discussion of basic hospital services and the solution of the many problems confronting the planners from first choosing the site to the completion of construction.

3. Elements of the General Hospital—detailed plan of each room or department giving possible size, and arrangement or location of

necessary equipment.

4. Hospital Equipment List—highly detailed list of standard and expendable items used within the elements of the hospital unit; herein is a description of how the architect and hospital administrator figure construction, operation and maintenance costs before a hospital unit is built. This will classify its economy.

This book is certainly, then, a wealth of information for the hospital planners since many of their questions will be answered somewhere within the four sections.

Overall, the young graduate architect or doctor, or the established architectural firm or hospital can increase their knowledge of the newest means in the medical field with which to heal the sick or to prevent sickness and bring about a greater degree of health in this country and abroad.

EXPERIMENTAL ATHEROSCLEROSIS.

By *Louis N. Katz, M.D.*, Director, Cardiovascular Department, Medical Research Institute, Michael Reese Hospital, Chicago, and *Jeremiah Stamler, M.D.*, Research Associate, Cardiovascular Department, Medical Research Institute, Michael Reese Hospital. Publication number 124, American Lecture Series, monograph in Bannerstone Division of American Lectures in Metabolism. Edited by *Paul Gyorgy, M.D.*, *Louis Leiter, M.D., Ph.D.*, and *S. O. Waife, M.D.* Cloth. Price, \$10.50. Pp. 375, with 37 illustrations. Charles C Thomas, Publisher, 301-327 E. Lawrence Ave., Springfield, Ill.; Blackwell Scientific Publications, Ltd., 49 Broad St., Oxford, England; Ryerson Press, 299 Queen St., W., Toronto 2B, 1953.

Experimental Atherosclerosis is an important monograph in the Bannerstone Division of American Lectures in Metabolism. It consists of a critical review of the pertinent literature and extensive research by Katz and a large group of associates working in the Cardiovascular Department of the Medical Research Institute of Michael Reese Hospital in Chicago. The bibliography contains 713 items. The research program itself was made possible by grants-in-aid from the Life Insurance Medical Research Fund, the National Heart Institute of the U. S. Public Health Service, the American Heart Association and ten additional funds.

The monograph deals only with atherosclerosis which is one of several distinct entities classifiable under the generic term arteriosclerosis. The authors point out that a study of this disease is significant because atherosclerosis is the great human killer, claiming at least 200,000 lives annually in the United States alone. They set the stage for their own work by reviewing literature indicating that arteriosclerosis is by no means the inevitable result of physiological aging

processes. The premise from which the study proceeds is that altered cholesterol-lipid-lipoprotein metabolism plays a key role in atherogenesis. If the disturbance in lipid metabolism can be prevented or reversed the possibility exists of eliminating atherosclerosis or ameliorating the chronic ills which result when intimal atheroma impair the blood supply to the heart, brain and kidneys. Every physiatrist will be interested in what the authors have to say about the hazards of negativistic attitudes toward the inevitability of the so-called "degenerative" diseases of senescence. They believe that elucidation of the mechanism of atherosclerosis through patient experimental research may eventually permit man to alter his own natural history for the benefit of humanity.

The bulk of the monograph is concerned with the exhaustive researches of the Michael Reese group. Convincing evidence is presented indicating that the primary lesion of atherosclerosis is relatively acute and focal and that the sclerotic processes which supervene are secondary phenomena related to the tissue irritant effects of cholesterol. Atherosclerosis occurs without gross hypercholesterolemia, and appears to be associated with the presence in the plasma of a particular class of cholesterol-bearing lipoprotein molecules. The evidence suggests that atherogenesis is at least partially reversible when dietary fat and cholesterol are restricted. The authors believe that the key to the grave atherosclerosis problem lies in the cholesterol concept of atherogenesis and with its solution "the eventual control and elimination of this malevolent disease."

PERIPHERAL NERVE INJURIES. Principles of Diagnosis. By *Webb Haymaker, M.D.*, Chief, Neuropathology Section, Armed Forces Institute of Pathology, Washington, D. C., and *Barnes Woodhall, M.D.*, Professor of Neurosurgery, Duke University School of Medicine, Durham, North Carolina. Second edition. Cloth. Price, \$7.00. Pp. 333, with 272 illustrations. W. B. Saunders Company, West Washington Square, Philadelphia, 1953.

The second edition of this volume is a fairly complete and well illustrated text concerning peripheral nerve injuries. Since the first edition in 1945, the authors have had the opportunity to add to their data a greater amount of information which has been made available from the follow-up studies of peripheral nerve injuries incurred during World War II. Most of this additional information concerns newer concepts in the pathological changes induced by different degrees of nerve injuries.

A new chapter has been added concerning the classification, causes and symptomatology of nerve injuries with new illustrations.

Although in this edition the authors have

given additional discussions relative to the tests employed in the diagnosis or prognosis of nerve injuries, it is to be regretted that discussion of electrodiagnosis, and particularly electromyography, is limited to approximately three pages. In subsequent editions, the incorporation of discussions of the newer concepts in electrical stimulation, electrodiagnosis and electromyography would be a helpful addition to what otherwise is an excellent and quite complete volume.

THERAPEUTIC USE OF POOLS AND TANKS. By *Charles L. Lowman, M.D., D.Sc., F.A.C.S., F.A.A.P.E.*, Director of Education and Rehabilitation, Orthopaedic Hospital, Los Angeles and *Susan G. Roen*, Director of Physical Therapy, Orthopaedic Hospital, Los Angeles. Paper. Price, \$3.00. Pp. 90, with 196 diagrammatic illustrations. W. B. Saunders Company, West Washington Square, Philadelphia, 1952.

This manual covers the subject of the therapeutic use of pools and tanks very well. It gives in detail the construction and maintenance of pools and tanks, and the equipment used.

A most important section is devoted to the technic of exercises in water. The indications and contraindications for various diseases and disorders is also given. Line drawings are numerous and are exceptionally well done.

A manual such as this has long been needed and should be very helpful to students and physical therapists. Hospital administration will also find practical information about the installation of such equipment.

HEALTH YEARBOOK 1953. Compiled by *Oliver E. Byrd, Ed.D., M.D., F.A.P.H.A.*, Professor of Health Education, and Director, Department of Hygiene, School of Education, Stanford University. Foreword by David K. Brace, President, American Academy of Physical Education (1952-53), and Chairman of the Department of Physical and Health Education, The University of Texas. Cloth. Price, \$3.50. Pp. 280. Stanford University Press, Stanford, Calif., 1953.

The "Health Yearbook 1953" is the tenth in the series edited by Dr. Byrd, Professor of Education and Director of the Department of Hygiene at Stanford University.

In the current edition, Dr. Byrd reviewed significant health facts and various new discoveries as recorded in the scientific, medical and popular literature of the world from the period of July 1952 through June 1953. The subject matter covers a rather wide spectrum, from health as a social accomplishment, which is the first chapter, to trends and possibilities, forecasts, etc., having to do with further development of health services throughout the world.

Of interest to physiatrists, and to physical therapists are Chapter V, reporting on exercise and body mechanics; Chapter VI, fatigue and rest; Chapter XIII, devoted to safety and Chapter XVIII devoted to occupational health. For example, Dr. Byrd quotes an article on page 119, which concludes with the concept that rehabilitation is a part of Industrial Medicine. On the following page is a rather interesting survey of 25 Safety Crown workers, which is a positive approach to a group of workers with a better than average safety record, and an analysis of their personality makeup.

Between the covers of this book are many interesting and stimulating facts, which are of general interest to people in all walks of life, and a number of facts which are of particular interest to those members of the therapeutic team, who are interested in Physical Medicine and Rehabilitation. This book is recommended for physicians, physical therapists, social workers, and others who want a thumbnail sketch of interesting and reliable data, accumulated in a recent twelve month period.



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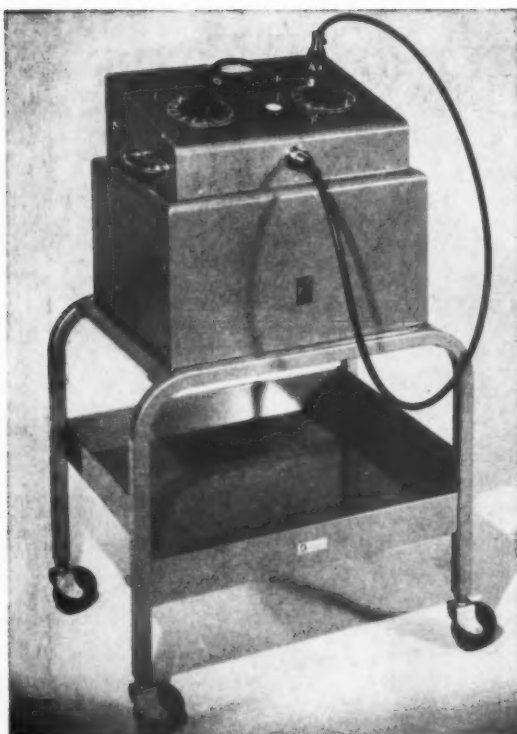


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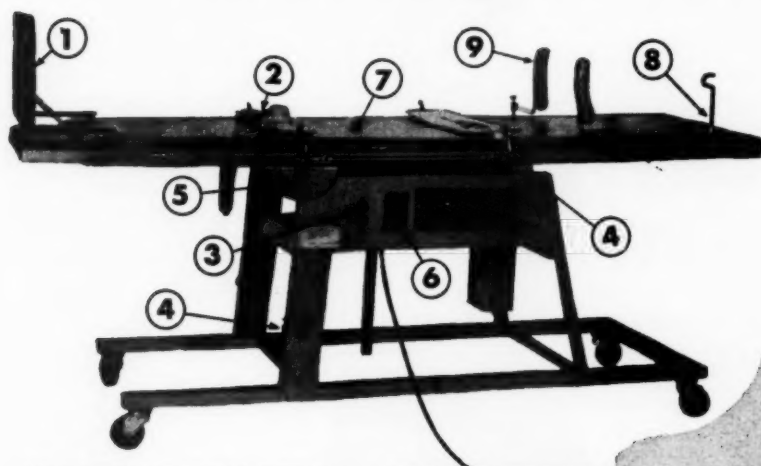


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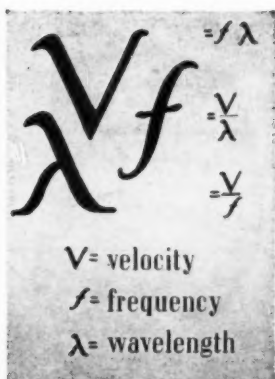


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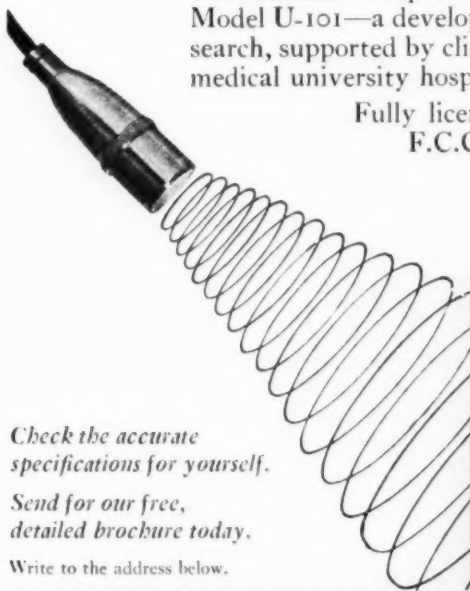
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